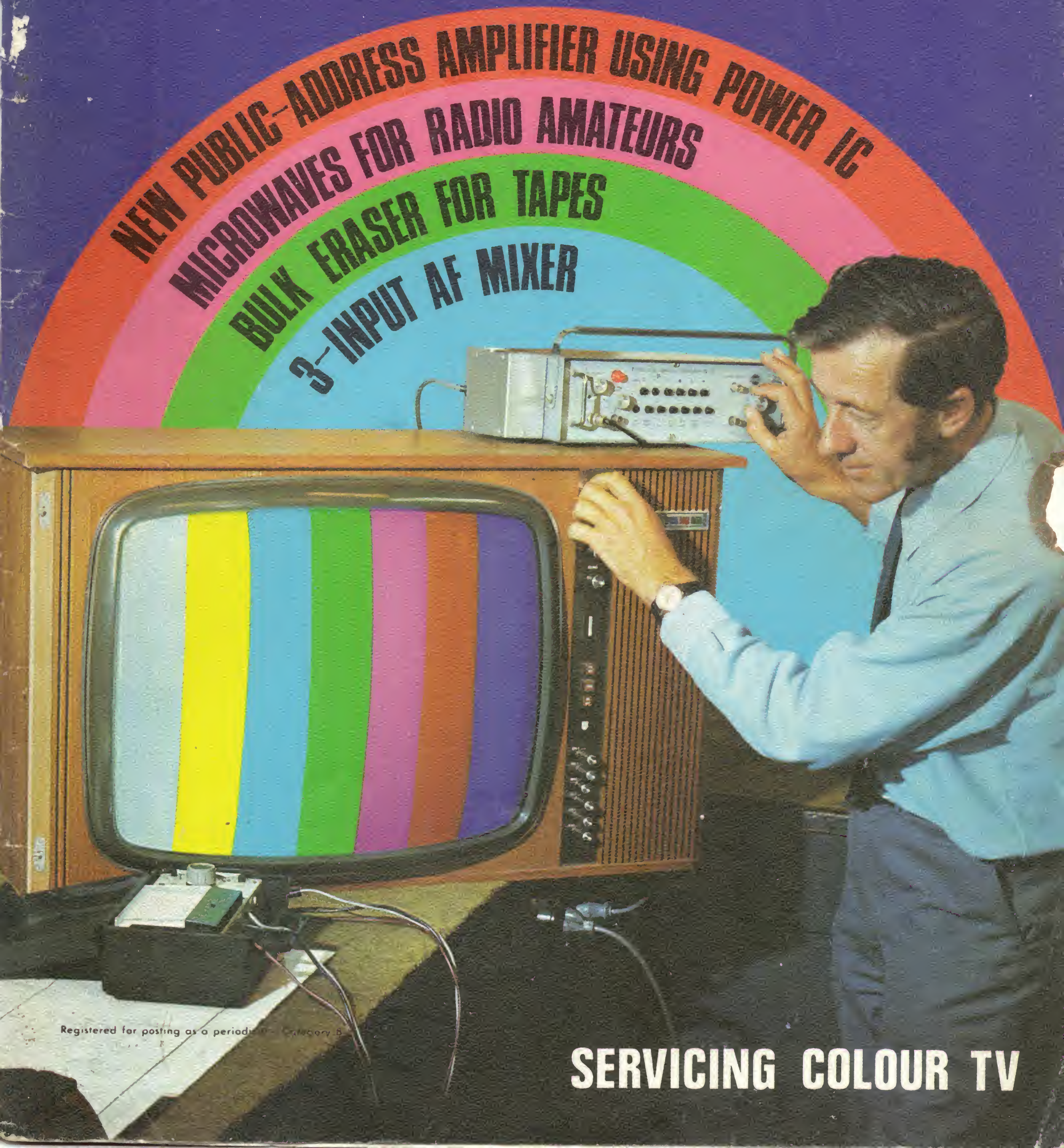
JUNE 1972 AUSTRALIA'S LARGEST-SELLING ELECTRONICS & HI-FI MAGAZINE

ELECTRONICS Australia

50c*

Fiji and New Guinea 60c
Malaysia $2.50
New Zealand 60c



Registered for posting as a periodical — Category B

meet Sony's

big (and little) guns

in truly sensitive sound recording

Here is Sony's front line in a brilliant range of electret condenser microphones. They offer superior quality, great utility and pleasure to all kinds of operators — private and professional in the hi-fidelity field. Despite their comparatively low prices, their sensitivity and the quality of their sound equals the best condenser units available anywhere, as well as possessing additional advantages such as extremely low power requirements, stability, and easy miniaturisation.

The Sony MX-12 Microphone Mixer

One of a range of four microphone mixers, the superbly designed MX-12 is a low impedance, three channel stereo or six channel monophonic microphone and/or line input mixer with independent head type level controls for each channel. It is equipped with phone plug inputs too, and costs about $149.

Here are details of the four illustrated:

ECM-22P
A professional quality microphone with "phantom" power feed system so that it can be used in studios of broadcasting stations. It has a wide range of frequency response with sharp directivity. About $158.

ECM-21
A brilliant performer unidirectional microphone highly suitable for hi-fi recording or broadcasting and adaptable for hand or stand use. About $61.

ECM-19B
An excellent unidirectional microphone with built in wind screen. Ideally suited for outdoor use or interview work. About $36.

ECM-16
A tiny omnidirectional high quality microphone ideal for inconspicuous placement. Can be hung around the neck or clipped on a tie. About $31.

SONY®

JACOBY KEMPTHORNE

SYDNEY: 26 2651, MELBOURNE: 329 6866, ADELAIDE: 93 2388/9, BRISBANE: 44 4488, PERTH: 28 5725, LAUNCESTON: 2 5322, Agents: CANBERRA: 47 9010, NEWCASTLE: 61 4991, WOLLONGONG: 71 1132.

For further information please fill in the Reader Information Service coupon in this issue

ABC certified circulation in excess of 48,000

Readership in Sydney, Melbourne, Brisbane, Adelaide and Perth 211,000 (McNair National Readership Survey, May-September 1971)

ELECTRONICS Australia

Incorporating "RADIO, TELEVISION and HOBBIES" and "MODERN WORLD"

AUSTRALIA'S LARGEST-SELLING ELECTRONICS & HI-FI MAGAZINE

VOLUME 34, NO. 3

Meet Colin Francis, who recently joined our company. Mr Francis came to us from Lawson Publications, where he was founder Editor of the trade journal "Australian Electronics Engineering", and editor of other trade publications. At present Mr Francis is on a trip to the UK, where he is involved in consultations with our associated magazines in the IPC Electrical-Electronic Press and IPC Business Press groups.

Emergency issue

Because of an industrial dispute which affected the production of newspapers and magazines in the Sydney area, this issue of "Electronics Australia" had to be produced under emergency conditions. We were able to maintain the technical content substantially intact but some items and advertisements had to be curtailed or omitted. We would apologise to readers and advertisers for any inconvenience which might result. The printing schedule for subsequent issues may be affected but we will do our best to minimise delays.

On the cover

A number of television servicing organisations are already prepared for the introduction of colour TV into this country in March, 1975. Our cover picture shows Mr Jack Cardwell, of the David Jones service department in Sydney, adjusting a prototype colour receiver. He is using a Korting colour bar generator supplied by EMI (Australia) Ltd. Mr. Cardwell has completed a colour TV servicing course at Sydney Technical College.

CONTENTS — JUNE, 1972

world of electronics and hi-fi

projects and technical

regular features

EDITORIAL VIEWPOINT

Big problems with small orders

In Australia, as in many other countries, it has become increasingly harder in recent years to buy electronic components in small quantities. More and more, the youngster wanting to buy a few resistors or capacitors for a small project, the radio amateur who needs a valve or transistor for his transmitter, and the service technician who must have a certain part for replacement purposes have been finding themselves at a disadvantage.

Manufacturers have been finding it unprofitable to supply orders for small quantities, and are understandably reluctant to do so. Traditionally it has been the function of the wholesale distributor and trade stockist to buy in reasonably large quantities and resell in small lots. But in order to cover operating costs such companies must generally major on buying fast-moving components. Slower moving lines tend to become either "unavailable" or available only on special order — and this can often involve long delays.

There have been indications in the last few months that this situation is reaching crisis proportions. In city areas, high rentals are combining with rising wages to force wholesalers and trade stockists to either move to the suburbs, or else restrict their business wholly to the supply of complete equipment, systems and packaged kitsets.

Those who have been based in the suburbs or who have moved there have generally found that much of their business must be carried out on a mail order basis, due to their less convenient location. Yet here again rising postal costs and wages are making it less and less profitable to handle small orders. In some cases, stockists are being forced to refuse small mail orders on the grounds that by the time they fiddle around with money orders, postal notes and other forms of mail payment, they actually lose money on the transaction.

The irony of the situation is that when considered as a whole, "small order" sales account for very large numbers of electronic components. Small orders add up to big business, a fact that is widely acknowledged in Britain and the US.

Even the big manufacturers admit that there is a lot of untapped market potential here in Australia, in the small order business. Yet the situation continues to deteriorate.

Part of the answer may be to generate more enthusiasm and activity among home constructors and radio amateurs, and if this is the case then surely Electronics Australia and our contemporary journals are playing our part. But we can only do so much, and I suspect that more is going to be needed if the situation is to improve.

Perhaps by stirring the matter up here, I will prompt others into coming up with some additional answers.

—Jamieson Rowe

ON SALE THE FIRST MONDAY OF EACH MONTH

Printed by Wilke and Company Ltd, of Clayton, Victoria, for Sungravure Pty Ltd, of Jones Street, Broadway, NSW.

*Recommended and maximum price only

Editorial Office
12th Floor 235-243 Jones Street, Broadway, Sydney, 2007 Phone 2 0944. Postal Address: Box 2728, GPO, Sydney 2001.

Advertising Offices
Sydney — 8th Floor, 235-243 Jones Street, Broadway, Sydney, 2007. Phone 2 0944.
Sydney representative: Bill Summons.
Melbourne, — 374 Little Collins Street, Melbourne, 3000. Phone 67 7021.
Melbourne representative: Jeffrey Byrne.
Adelaide — Charles F. Brown & Associates Ltd, 429 Pulteney Street, Adelaide, 5000 Phone 23 1657.
Adelaide representative: Tom Duffy.
Perth — 454 Murray Street, Perth, 6000. Phone 21 8217.
Perth representative: Jack Hansen.

Representation
Melbourne — Sungravure Pty Ltd, 392 Little Collins Street. Phone 67 7021.
Brisbane — Sungravure Pty Ltd, 78 Elizabeth Street. Phone 21 6690.
Adelaide — Sungravure Pty Ltd, 104 Currie Street, Phone 51 3502.
Perth — Sungravure Pty Ltd, 454 Murray Street. Phone 21 8217.
Newcastle, NSW — Associated Newspapers Ltd, 22 Bolton Street, Phone 2 3696.
London — John Fairfax and Sons (Aust) Ltd, Reuter Building, 85 Fleet Street.
New York — "The Sydney Morning Herald" Ltd, 1501 Broadway, New York NY 10036.

Circulation Office
9th Floor, 235-243 Jones Street, Broadway, Sydney, 2007. Phone 2 0944.

Distribution
Distributed in NSW by Sungravure Pty Ltd, Jones Street, Broadway, Sydney; in Victoria by Sungravure Pty Ltd, 392 Little Collins Street, Melbourne; in South Australia by Sungravure Pty Ltd, 104 Currie Street, Adelaide; in Western Australia by Sungravure Pty Ltd, 454 Murray Street, Perth; in Queensland by Gordon and Gotch (A'asia) Ltd; in Tasmania by Davies Bros Ltd, Macquarie St, Hobart, in New Zealand by Gordon and Gotch (NZ) Ltd, Adelaide Rd, Wellington.

KP-3021 AUTO TURNTABLE. All you do is switch on, with this 24-pole synchronous motor turntable. Smooth, reliable, durable tone arm operation. Auto-play, auto-return, auto-stop . . . all electric and automatic. Freq. response 20-20,000 Hz.

What more could you want in stereo . . . even from Kenwood?

the sound approach to quality

KENWOOD

SYDNEY	630 7400	MELBOURNE	41 7551
ADELAIDE	93 6117	BRISBANE	44 4674
PERTH	28 5725	HOBART	34 2666
CANBERRA	47 9624	NEWCASTLE	61 4991

JACOBY MITCHELL

FAIRYMEADOW 84 8022

To: **Jacoby, Mitchell & Co. Pty. Limited**
P.O. Box 2009, North Parramatta, N.S.W. 2151
Please send me full details on Kenwood

☐ KP-3021 Stereo Turntable ☐ KL-7080 Speaker System
☐ KR-6170 Stereo Receiver, and location of nearest Kenwood Sound Centre.

NAME...

ADDRESS...

....POSTCODE..........................

JM/K-9EA672

AKAI

THE VERY REAL SOUND EXPERIENCE

SAVE $206 ON 1730-SS TAPE RECORDER

This is it! AKAI'S unbelievable new 4-channel "Surround Stereo". First true 4-source, 4-channel sound system—for 2-channel cost and compatibility, with 4-channel realism.

$399

(LIST: $605)

SAVE $154 ON AKAI GX-280D STEREO TAPE DECK

$599

(LIST: $753)

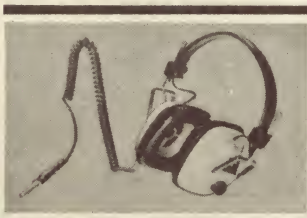
A uniquely designed 3-head 3-motor stereo tape deck . . . with exclusive lifetime guaranteed GLASS & CRYSTAL FERRITE HEADS. Automatic reverse and amazing frequency response of 30 to 24,000 Hz.

SAVE $71 ON AKAI SW131A SPEAKERS

Superb sound from this 3-way system. Features: 10" woofer and 5" mid range, both with Linear Travel Piston (LTP) edge and a 2½" tweeter with aluminium voice coil.
Buy now and save 40%!

$175

A PAIR (LIST: $246)



SAVE $6.45 ON AKAI ASE-9S STEREO HEADPHONES

With ACOUSTIC TONE CONTROLS, this great set of headphones gives the unparalleled sound quality you have come to expect from AKAI!

$12.50 (LIST: $18.95)

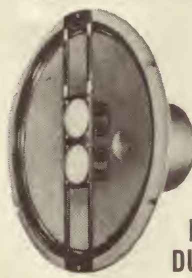
Peerless HIGH FIDELITY SPEAKERS

Direct imports from Denmark. ALLIED have a direct indent shipment of these world-famous loudspeakers. Available to the public now at way below previous cost prices!

PEERLESS KIT 20-3

40 watt power handling capacity in this Deluxe 8¼" 3-way 3-speaker system which may also be housed in 0.7 cubic foot cabinet, all details are provided. Speaker complement is woofer, mid range and tweeter. Frequency range is 40-20,000 Hz to match any high-quality high-power stereo amplifier.

$69 A PAIR



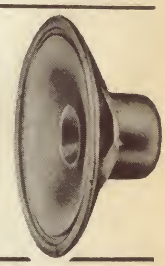
PEERLESS COAXIAL SPEAKERS

Coax 120-20-20	**$69** a pair
Coax 100-20	**$59** a pair
Coax 825-20	**$59** a pair

PEERLESS DUAL CONE SPEAKERS

0 825 FM Twin Cone

$19
A PAIR



Shop in person, or by mail!

EITHER WAY, YOU'RE SURE OF THE SOUNDEST DEALS AT ALLIED

40%

OFF THIS FAMOUS NAME COMPLETE HI-FI SYSTEM!

JUST $199

We've 25 of these quality sets going right now at cost. Think we're kidding? We almost wish we were. Take a look at what you're getting—$330 **wholesale** value for $199.

GARRARD MODEL 40B PLAYER
With magnetic cartridge, manual/automatic operation, automatic switch-off. Not to mention the Garrard reputation.

STANDARD HI-FI AMPLIFIER PM 157E
Solid-state, 18-transistor stereo unit with low distortion ratio, wide-power band width and personal headphone jack for listening alone. Input circuit incorporates tuner, phono, tape, aux for widest range of applications.

STANDARD LOUDSPEAKER SYSTEM MODEL 210K
Compact set prestige-finished in oiled walnut. Two-way system combining 8" Woofer for low sounds, high efficiency 4" tweeter for high sounds.
Teak finish cabinet for record player $19, if required.

SR STANDARD

SAVE $168 ON SR-606SE STEREO TUNER/AMP

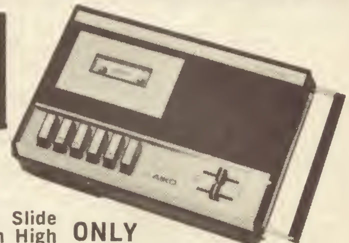
$199
(LIST: $367)

A tremendous buy for the enthusiast! Solid-state MW/SW/FM facilities. 100 watts music power with exceptionally low distortion. Piano-touch selection; slide-rule control of volume, tone and balance for really smooth operation.

SAVE $52.60 ON STANDARD SR-T186F
FM/MW/SW 3 Band Radio Cassette Tape Recorder with Mic-mixing. Unbelievable value!

$129
(LIST: $181.60)

OTHER ALLIED SPECIALS



AIKO ATP701
Solid State AC/DC Slide Control Push Button High Quality Cassette Recorder
No other similar machine can perform like this one for so little money!

ONLY **$59**

TEMPO $59
8 TRACK STEREO CARTRIDGE CAR PLAYER
Plus matched speakers from **$15** a pair (depending on type of car)

SYDNEY'S BIGGEST RANGE OF SOUND EQUIPMENT —AT THE LOWEST PRICES ANYWHERE!

EASY PAYMENT. Terms available on all equipment at Allied. Also lay-by.
TRADE-INS WELCOME. Everyone says it. We really mean it. And we give you top prices. Try us.
SOUND ADVICE. At Allied you'll get the best—and most straightforward and expert advice on every sound equipment problem.
AFTER-SALES SERVICE. Fast, reliable, low-priced.
FREE INSTALLATION. At Allied, delivery and installation of mains equipment is **absolutely free.**

210 Clarence Street, Sydney. 29 1704.
330 Pacific Highway, Crows Nest. 439 1072

Allied
Allied Music Systems

SEND FOR MORE DETAILS, OR THE LATEST ALLIED CATALOGUE
Complete today and mail to:—

ALLIED MUSIC SYSTEMS,
210 Clarence Street, Sydney,
New South Wales 2000.

Please send me, by return mail, free illustrated literature on ....

....

Check here for your FREE ALLIED Catalogue. ☐

NAME ....

ADDRESS ....

....

.... STATE .... POSTCODE ....

PHONE NUMBER AMS.6

TALKING TO THE WORLD

the story of the BBC External Engineering Service

*by D. A. V. Williams, BA, MIEE **

Every day, the British Broadcasting Corporation transmits over 100 hours of radio programs in 40 different languages for reception overseas. The technical facilities used to ensure adequate reception in the areas to which the programs are directed are described in this article.

In the greater part of the world radio is still in a stage of development brought about by the transistor revolution. Compact radio sets, with a performance on medium and shortwaves which was unthought of at such a low price only a few years ago, have brought the outside world to the doorsteps of ordinary people in even the most remote countries.

It is to meet the challenge of reaching and holding this ever-expanding audience that the BBC's External Services are broadcasting over 100 hours of programs in 40 different languages throughout the 24 hours of each day of the year. The BBC's External Services are not alone in competing for the world's audience, as more than 60 other countries or organizations are also broadcasting to overseas listeners.

It is the work of External Services Engineering to provide, maintain, and operate the technical facilities needed to produce the programs and to broadcast them throughout the world outside the United Kingdom, so that they can be heard loudly and clearly in the countries to which they are directed.

This calls for coverage of the major population areas of the world for long periods each day with transmissions which are free from interference and competitive in signal strength with the multitude of signals from other broadcasting organizations. To carry out this task effectively requires that the transmitting network is planned on a world-wide basis and uses, wherever practicable, relay stations near to the areas to be served so that the signals can be as strong as possible.

In planning the transmitter network, account has to be taken of the listening habits of the audience, the availability of frequencies, the capital and running costs of the technical plant, and the present and future performance of domestic receivers. Before 1950 HF broadcasting was essentially a medium for broadcasting over very long distances. However, during the 60s it tended to become a medium for regional coverage up to a distance of 3000 miles from the transmitting station. This was brought about by the desire of the broadcasters to simplify their short-wave frequency planning. Thus the average listener finds some measure of the stability of frequency usage to which he has become accustomed by medium-wave listening.

Also, the overcrowding of the short-wave broadcast bands and the comparative insensitivity of the cheaper transistor radios using short whip aerials, set a need for high signal strengths which is most easily met by using relay stations within one-hop range of the target areas. Relay station development has therefore to be balanced between the use of medium-waves which all radios can receive, but which for the distances involved are limited to night-time use only, and short-waves which can give a service throughout the 24 hours but are received on only a proportion of receivers.

The aim of External Services has been to provide both medium and short-wave coverage of concentrated population areas, for example, Europe, the Indian subcontinent and the Middle East, and to provide short-wave coverage of the more scattered land areas such as Africa and South America (although in time it is hoped to be able to provide a complementary medium-wave coverage to some of these areas).

The External Services use a total of 70 highpower transmitters. Of these 46 are at sites in the UK and 24 at relay stations overseas. These relays, depending on circumstances, are operated either by the BBC or by the Diplomatic Wireless Service of the Foreign and Commonwealth Office. They all, however, broadcast solely BBC programs originated in Bush House, London, on frequencies and at times scheduled by External Services Engineers.

The main transmitting sites in the United Kingdom are at Daventry (Northants), Rampisham (Dorset), Skelton (Cumberland), Wooferton (Shropshire) and Crowborough (Sussex). Wooferton is chiefly used for relaying "Voice of America" programs originating in the United States; and Crowborough for broadcasting to Europe on medium-wave via its 600KW transmitter.

Of the 46 high-powered transmitters in the

The interior of the receiving station at the BBC's Eastern Mediterranean relay station, one of six relay stations located around the world.

* *The author is Chief Engineer, BBC External Broadcasting.*
This article is reproduced from "Sound and Vision Broadcasting", published by The Marconi Company, England, by arrangement with the editor.

United Kingdom, 20 have a power of 250KW and the remainder are rated at 100KW. Additionally, three 30KW single-sideband transmitters are available for use as point-to-point feeds to the overseas relay stations. Twenty-six of these transmitters are of modern design and have been installed within the last 13 years. The remainder date from the Second World War and will be in need of replacement shortly.

The signals from the UK transmitters are currently reinforced by six relay stations located in suitable positions around the world. In Europe the External Services are relayed in Berlin on both medium-waves and VHF. In Asia, the Eastern Relay Station, which came into service on June 1 1969, serves India, Pakistan, Afghanistan, Iraq, the Arabian Peninsula and the Gulf area. It operates on medium-waves with a maximum power of 1500KW and broadcasts both the World Service (a 24-hour service in English), and vernacular services for the areas concerned.

The majority of these are dual-band curtain arrays with gains of around 20dB over an isotropic radiator. A proportion of the arrays are slewable by $\pm 20^\circ$ so that they can be used to serve important target areas off the normal axis of the array. Very few rhombic or log-periodic arrays are used as, in general, the former have too narrow a main lobe for area broadcasting while the latter have insufficient gain compared to curtain arrays.

Normally the maximum power used on short-waves is 250KW from a single transmitter. However, equipment exists at some stations to enable two 250KW transmitters to be combined to give a power output of 500KW. The method which is used employs separate feeders for each transmitter connected to adjacent halves of curtain aerial arrays. Probes underneath the array enable the phases in each half to be compared, and a DC signal, which can be used to control, manually or automatically, the phase of one transmitter, is returned to

watch to be kept on the overall audibility of the transmissions, and to identify the origin of interfering signals, to indicate any corrective action which may be needed.

The reporting system available to External Services covers most areas of the world and information is received from a variety of sources, such as the Overseas Relay bases, voluntary reporters, official posts and the general public. The total number of reports received is very large, especially after the introduction of a new seasonal schedule. It is quite normal in one such week to have 10,000 reports on various frequencies from as many as 250 different locations.

In the past this information had to be collated manually. This meant that either the results were not known until many weeks after the introduction of the schedule, or could only be sampled with the possibility of error if they were to be available in time for corrective action to be taken.

A computer program is now available

The main transmitting hall at the BBC's External Services transmitting station at Skelton, Cumberland, England.

The 250KW screened trunk feeders and switching station at the Skelton transmitting station.

The Eastern Mediterranean Relay Station operates on medium-waves for the Arabic, Persian and World Services. It also relays these and other services on short-waves to the Middle East and parts of Africa, Asia and Europe. The Arabic Service is also relayed by a medium-wave transmitter in Malta. The Far Eastern Relay Station carries, on short-waves only, the World Service and most of the Asian language services originated by the BBC in London for South and South-East Asia and the Far East. The Atlantic Relay Station on Ascension Island, using four 250KW short-wave transmitters, broadcasts the World Service and vernacular services for most of Africa and South America.

Between all the transmitting sites there is a choice of over 400 directional aerials for beaming the signals towards the target areas for which the programs are intended.

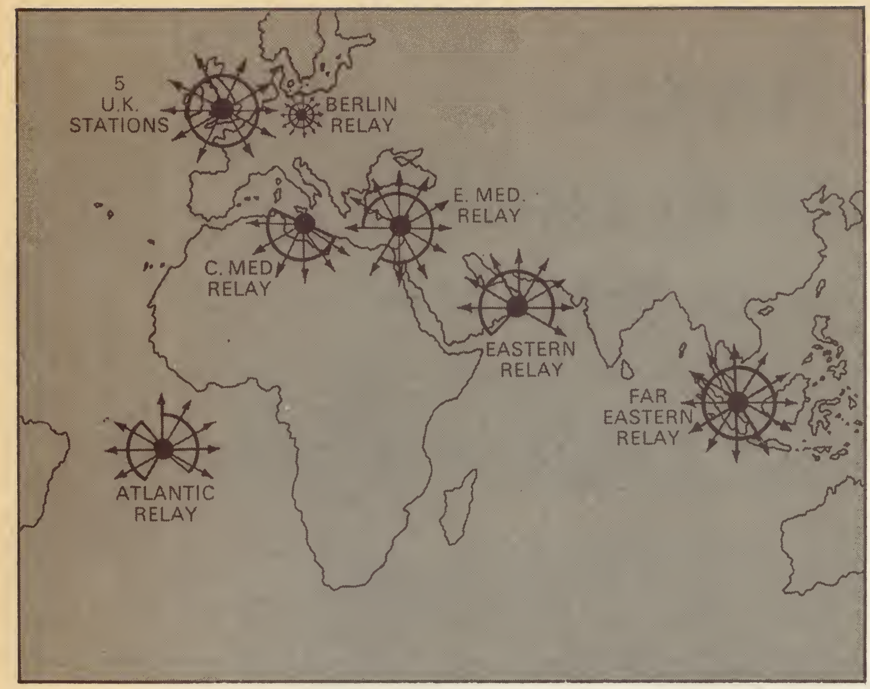
the transmitter hall. This system enables existing feeders to be used and the direction of the main beam to be slewed by adjustment of the phase of one of the transmitters. The 500KW transmissions are normally limited to use on especially difficult transmission paths, or where interference makes the power necessary. Another technique which is extensively used is to operate two or more transmitters synchronously on the same frequencies with each transmitter working into separate arrays on different bearings. The transmitters can either be on the same or different sites and often three 250KW transmitters on the same frequency are employed.

According to the short-wave schedule currently in operation, up to 125 different frequencies can be used on any one day. It is therefore essential to have a reception reporting system to enable a continuous

which enables all reports to be tabulated and collated on either frequency or location basis and allows a comprehensive report to be made available within a few days of the introduction of new schedules.

All programs are produced or assembled in one or other of the 48 studios in Bush House from where they are fed by Post Office cables or links to the UK transmitting sites. The relay stations normally pick up the direct UK broadcast signals for relaying to their adjacent areas, though in some cases direct point-to-point SSB transmissions are used to provide additional relay facilities. Cable and satellite circuits are also used although, due to their expense, they are normally limited to periods of poor propagation conditions, or for special occasions.

As an alternative to direct relays about 20% of the programs are pre-recorded on magnetic tape and sent out by air freight.



An approximate coverage diagram of some of the BBC's overseas relay stations.

By this means the program quality for less topical items can be maintained at a higher level than is normally possible via radio pick-ups. Nevertheless, relay quality of a high order is achieved by the use of diversity reception and receivers specially modified to reduce distortion while retaining good overall audio-frequency response.

The assembly of the language programs into streams at networks and their connection at precisely timed intervals to the outgoing lines involves a very large number of daily switching operations. This results from the number of languages broadcast, and the frequent changes of transmitters which are necessary to make the most efficient use of the facilities available. At present these switching operations are carried out by "Uniselector" stepping switches operated back to back. The sequence for each seasonal schedule is set up manually by inserting markers in the switches to identify source, time and destination routing.

This equipment, which has been in service for 13 years, is now being replaced by a more flexible system which will be controlled by a small computer. The new system will allow switching in five-minute time blocks instead of the present 15 minutes and give more flexibility to program planning. The use of modern input and output peripheral equipment will also enable the setting-up time and staff requirements to be reduced.

Most of the studios at Bush House are small and specially designed for the news and interview types of program which comprise the major part of External Services output. A few studios are available for music and plays, of which the largest can contain an audience of 50 and a small orchestra. A recent innovation has been the installation of several small studios which can be directly operated by non-technical staff. A feature of these studios is the use of a relatively complex compressor / limiter amplifier for controlling signal levels. This enables the producer to concentrate more on program content than technicalities when operating the studio on his own.

In addition to the direct broadcast facilities, studios and equipment are available for making transcription recordings for distribution overseas, either on stereo gramophone records or magnetic tape. These recording facilities have been built to very high standards and can provide complete programs on disc which are equal to the best commercial records currently available. They are widely used by overseas broadcasters for transmission on their local radio stations, and have achieved such a reputation for artistic and technical excellence that they are often used as a standard for judging the performance of broadcasting plant.

With the studio and transmitting facilities now available, it is possible for listeners in most parts of the world to receive strong signals from the BBC, either in English or their own language, during the local peak listening periods. A program of capital development is planned which, when funds are made available, will enable the process of modernising facilities in the UK to be completed and, by the construction of additional relay stations, will improve the present reception gaps in Europe, Africa and Latin America.

The possibility of direct broadcasting from satellites is kept under review, but with present costs and problems of frequency and receiver availability, satellites do not seem for many years to be able to offer a viable alternative to the present system of terrestial broadcasting. This is especially true when the requirement for broadcasting up to six simultaneous transmissions in different languages is taken into account. Whatever the future holds, the BBC's External Services have both the program and technical expertise to meet the challenge of reaching and holding the ears of the ever increasing audience resulting from the universal availablility of transistor radios.

how on earth could you improve the SANSUI AU555A

~and still pay a maximum of $237?

With a recommended maximum price of only $237* the Sansui AU-555A solid state stereo amplifier offers a great deal more to the dollar wise Australian audio enthusiast.

Continuing development by Sansui, Japan's leading audio-only manufacturer, has resulted in a fine stereo amplifier with every desirable feature . . . the total power output is 60 watts into 8 ohm speaker systems, and the frequency response is ±1 dB from 20 Hz. to 40 kHz. at normal listening levels.

There's loads more . . . bass, treble and *mid-range* controls, provision for two pairs of stereo speakers, all the usual Sansui filter and mode controls . . .

And here's the most vital point of all. In terms of *tonal quality* the Sansui AU-555A leaves similarly priced competitors a long way behind. Some dedicated enthusiasts claim there's little perceptible difference in tonal quality between the AU-555A and the top-of-the-line Sansui amplifier, the AU-999.

However, as selecting a new stereo amplifier is a *personal* matter, you are cordially invited to slip along to your favourite Simon Gray franchised dealer. Listen to the Sansui AU-555A *critically*. See how much more *total performance* Sansui offers — and how much more you get for your money. *Call in today!*

Sansui

**Recommended maximum price only.*

Simon Gray Pty. Ltd.,
28 Elizabeth St.,
Melbourne 3000.

Please send me further information about the Sansui Model AU-555A and the name of my nearest franchised Simon Gray dealer.

Name...

Address...

..............................**Postcode**...............

Simon Gray Pty. Ltd.

DISTRIBUTORS:
Australia, excepting W.A.: *Simon Gray Pty. Ltd.* ***Head Office:*** *28 Elizabeth Street, Melbourne. 3000. Tel. 63 8101*. Telex: 31904.* ***Sydney Office:*** *53 Victoria Avenue, Chatswood. N.S.W. 2067. Tel. 40 4522*.* ***Canberra Office:*** *25 Molonglo Mall, Fyshwick, A.C.T. 2609. Tel. 95 6526.* ***Adelaide Office:*** *301 South Terrace, Adelaide, S.A. 5000. Tel. 23 6219.* ***N.T.:*** *Pfitzner's Music House, Smith Street, Darwin. 5790. Tel. 3801.* ***Qld.:*** *Sydney G. Hughes, 154-158 Arthur Street, New Farm, Brisbane. 4005. Tel. 58 1422.* ***Tas.:*** *K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. 7250. Tel. 2 5322.* ***W.A. Distributors:*** *Carlyle & Co. Pty. Ltd., 1-9 Milligan Street, Perth. 6000. Tel. 22 0191.* ***Sansui equipment is manufactured by:*** *Sansui Electric Co. Ltd., 14-1, 2-chome, Izumi, Suginami-ku, Tokyo, Japan.*

General Electric/Centre Industries link provides Australian-made diodes

Three-way agreement brings the technology behind GE's transient protected diodes to Australia; at the same time brings new and challenging job opportunities for disabled people.

by JAMIESON ROWE

As the result of a three-way manufacturing and marketing agreement between General Electric in the USA and Australian General Electric and Centre Industries in Sydney, NSW, GE's highly successful A-14 series of glass passivated silicon rectifier diodes is now being made in Australia. Only a few weeks ago the first production quantities of the devices came from the new production line which has been set up at Centre Industries' facility in Allambie Heights, a few miles north-west of Sydney's Manly beach.

Centre Industries is a research, training and manufacturing facility operated by the Spastic Centre of NSW to train, assist and provide effective paid employment for a wide range of severely disabled cerebral palsied and other physically disabled people. Under the agreement with GE in the US, they are making the A-14 series devices, while AGE are taking care of marketing.

For AGE the venture means that their customers can now be assured of a continuous supply of the full range of A-14 series devices, with PIV ratings from 50V to 1000V at 1A. Local manufacture will also give them the ability to compete more effectively with overseas component makers, and the opportunity to expand into export markets.

But it would be wrong to think that GE and AGE are only working with Centre Industries for purely commercial reasons. Like many others, they are very impressed with the way CI is achieving a humanitarian goal while still operating as a viable commercial undertaking.

This is expressed by Bryan Catt, AGE's astute National Manager for electronic components: "Centre Industries is a unique business enterprise. They are really showing the world what disabled people can do if they are helped out of sheltered workshops and slotted into a more normal working environment. We're proud to be working with them."

Although CI have been making electromagnetic relays and relay sets, switching modules and other related equipment for some time, this is their first venture into the fast-moving field of semiconductor component manufacture. They are quite excited about the prospects. General Manager Bruce Hume explains: "We believe this contract is providing us with a bridge to modern technology, and that it will enable us to lift and broaden the employment horizons which we can offer to disabled people."

Centre Industries have built a new extension to their Allambie Heights plant to house the diode line, together with an associated testing lab, chemical lab and water purification plant. GE provided two experienced production engineers, John Tworek and Bob Denne, to help CI set up the new line. The setting-up took John, Bob and CI staff engineer Rex Torzillo just three months, which is very short considering the specialised technology involved. Already the production yields are impressively high, despite stringent GE quality control and reliability checks to ensure that the local products fully conform to specs.

For the initial phase, to allow the line to be established with a minimum of complications, most of the CI employees working on the line have been non-disabled. But now that the line is operating smoothly, CI are implementing the second phase of the operation — aimed at achieving close to 50% participation by disabled employees. This is in line with their basic philosophy of providing "integrated" employment opportunities for the disabled. G-M Bruce Hume anticipates that on the basis of their previous experience in adapting plant and training disabled employees, the 50% participation goal should be achieved in about six months.

The three-way link between GE, AGE and Centre Industries is working out so well that expansion of the operation to cover more semiconductor products is already being mooted. For those keen to see Australia acquire more expertise in modern electronics technology, this is good news.

INDUSTRIAL ELECTRONICS TECHNICIAN

A technical level course covering basic theories as well as advanced subjects. Data Processing and Electronic Computers are covered in some detail. Among other subjects dealt with are:—

Electronic Welders
Motors & Generators
Magnet Amplifiers
Process Control Systems
Servomechanisms
Timing & Control Circuits

RADIO ELECTRIC TELEMETRY

An ideal course for those wishing to specialise in this field as well as for engineers whose specialty lies in another area.

ELECTRONICS MAINTENANCE

As Industry utilises more electronic equipment there is an increasing number of openings in the Electronics Maintenance field. This course covers:—

Electrotechnics
Electronics
Maintenance

COLOUR TV

Colour TV is on the way and this course has been designed to give the trained technician a good knowledge of the principles. The NTSC and PAL systems are discussed in detail.

ELECTRONIC INSTRUMENTATION & CONTROL SYSTEMS

This course has been designed for electronic technicians interested in industrial instrumentation and control and who work in plants utilising automatic control processes.

Dynamic! Go-ahead!—the careers of the 21st century where your opportunities are unlimited! For the best training and knowledge, for the top salary and positive success—get the personal touch with ICS. Individual home study in your own spare time. Select your course then mail the coupon for free brochure.

RADIO-TELEVISION SERVICING

This course can be the starting point of a busy, profitable career. Students will learn how to install, calibrate and keep in repair modern radio and television cells. No prior knowledge is assumed and this is an ideal course for beginners.

ELECTRONIC DRAFTING

Suitable for those wishing to specialise in Electronic Drafting. Course covers modern drafting practice, in symbols and schematic drawings. Suitable both for beginners as well as experienced draftsmen wishing to make transition into the Electronic field.

SOLID STATE ELECTRONIC TECHNOLOGY

An advanced course for engineers and technicians who wish to advance their knowledge of solid state theory and hardware. The course covers the latest developments in semiconductor-diode and transistor circuiting.

COMPUTER TECHNICIANS

Programming is included as well as instruction on the technical aspects of computers. The course is designed to assist technical personnel concerned with the installation, maintenance and operation of digital computers.

FUNDAMENTALS OF ELECTRONIC COMPUTERS

A course designed for both beginners and for experienced technicians desiring a fundamental knowledge of electronic computer circuits and their applications. The course has been written in an easy to understand manner.

TRANSISTOR RADIO AND PRINTED CIRCUIT SERVICES

Ideal for radio engineers and those who already have a knowledge of valve receiver theory but require systematic study of the more modern techniques employed in transistor radio receivers.

Microcircuit to keep drunken drivers off roads

Statistical studies in both the US and Australia have shown that at least half of the road accident fatalities in both countries are related to the drinking of alcohol.

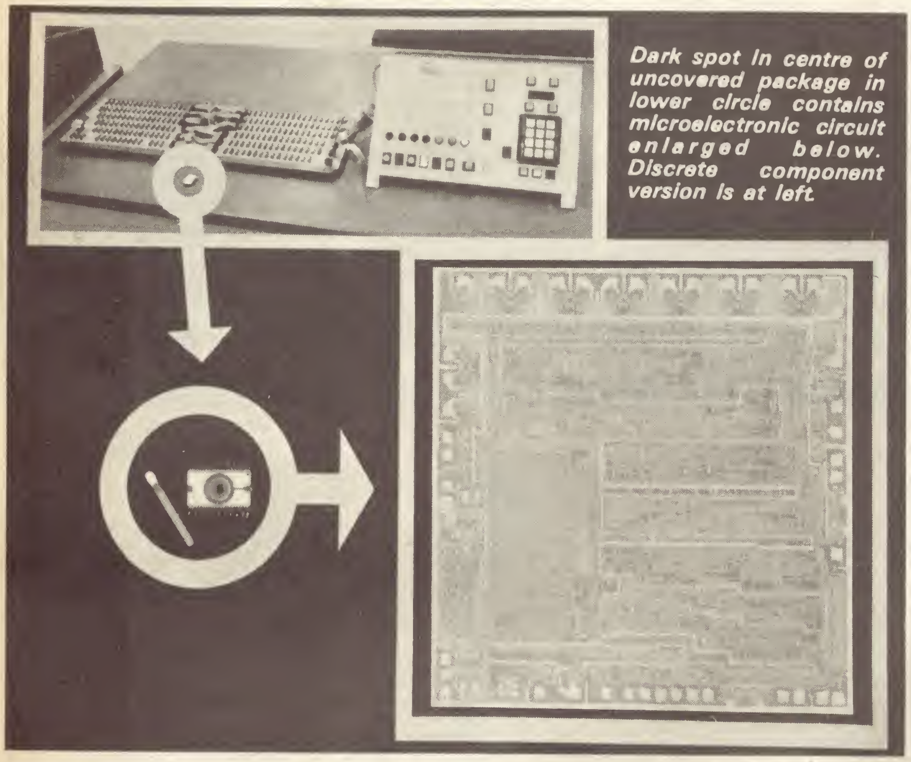
Concern about drinking drivers and the destruction of life and property they cause has inspired General Motors to develop a device designed to prevent drunken motorists from starting their own cars.

The GM ignition-lock device, named Phystester, has the added advantage that it hinders motor car thieves even if the keys have been left in the car. It also prevents people from starting their cars if their faculties are impaired by other causes such as drugs or illness.

A laboratory model of the Phystester was built and has been under test for some time now by GM's Delco Electronics Division. The laboratory model looked promising — so much so that its designers decided to have the display, response and memory storage circuits miniaturised so the unit could be installed in a car's dashboard.

Under contract to GM, the North American Rockwell Microelectronics Company, which is primarily an aerospace contractor, successfully reduced the hatbox full of conventional electronics parts down to a piece of silicon roughly the area of the head of a match. The large scale integrated (LSI) circuit is produced by the company's metal oxide semiconductor (MOS) process. NR Microelectronics is the largest manufacturer of MOS/LSI circuits in the world.

Containing 4,641 transistors for logic and display functions, the MOS/LSI circuit also has enough memory storage for a variety of electronic lock codes and the five-digit numbers that are displayed briefly to the motorist.



Dark spot in centre of uncovered package in lower circle contains microelectronic circuit enlarged below. Discrete component version is at left.

How it works

When installed on a car's dashboard, the Phystester is designed to operate as follows:

(1) After turning the ignition key, the driver has to punch five buttons in correct order to insert the car's code-lock number. The car will not start unless its own code-lock number is inserted.

(2) Then the driver punches a "set" button causing a random five-digit number to appear on the display for a few seconds. The driver has to memorise this number and punch the correct five buttons within a preset time or the car will not start.

Other complications are also being considered, such as a secondary signal requiring the driver to apply the brakes within a preset time. The number sequences and secondary signs of driving capability are still under study to validate them as indicators of a motorist's ability to drive safely.

Tiny computer memories switch colour at the molecular level.

Computer memories may shrink even more if a newly invented molecular memory material proves commercially feasible. Thin sheets of the new material, patented by US Navy researcher Irwin Schneider, should be able to store more than 10^7 bits per sq cm, as compared to 10^5 bits per sq cm for existing disc memories.

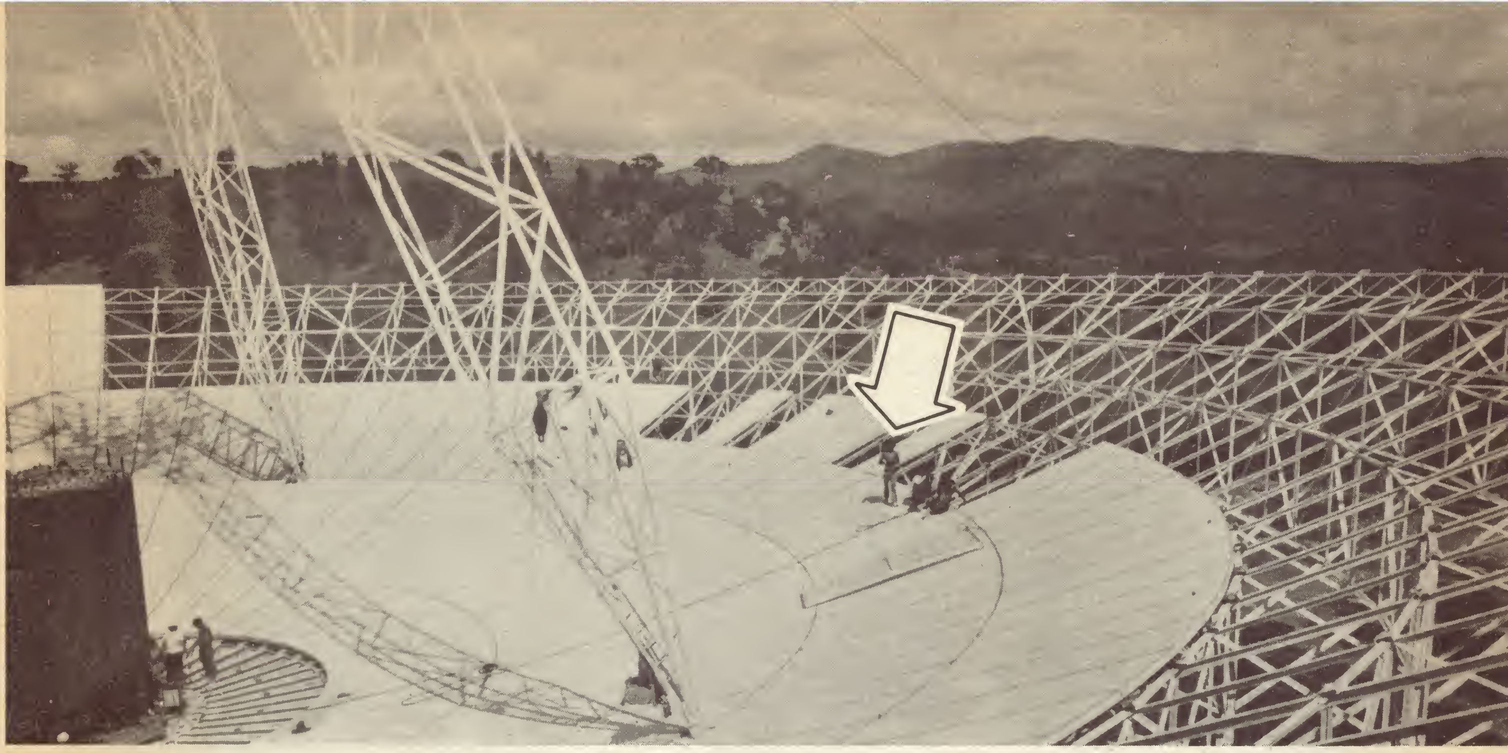
The method of operation depends on the optical properties of potassium chloride, which is normally a clear crystal, but which can be coloured by impurities. A potassium ion ($K+$) is in this case replaced by a sodium ion ($Na+$) and two adjacent chloride ions ($Cl—$) are replaced by electrons.

Dipoles formed by the electron pairs are initially all aligned in one direction. But when the molecule is hit by polarised light at 620nm, the light rotates the electron pair about the sodium ion so that it ends up perpendicular to its original position.

The original orientation represents an "0" and the perpendicular orientation a "1" in the binary code.

Light at 820nm causes the dipole to radiate at 1080nm without disturbing its orientation, but the polarisation of the radiation will depend on dipole orientation. The memory can therefore be read by shining a beam of 820nm light on the molecule and determining the polarisation of the radiated beam.

Holography is planned as an input/output method; the new memories would therefore require no electrical connections.



NASA'S 210ft space antenna near completion at Tidbinbilla

PERFECT PARABOLIC SURFACE on an immense scale is the problem faced by the antenna's builders. Size of the dish can be appreciated by comparing it with the size of the workmen shown above. The 210ft dish, over six times as sensitive as the 85ft antennas, will significantly extend the useful life of interplanetary spacecraft.

Australia will soon be the only country in the world with two 210ft (64m) space communication antennas. The new one at Tidbinbilla has been structurally completed and electronic components are now being installed.

The 7,000-ton antenna is similar to the 210ft NASA antenna at Goldstone, California, which until now has been NASA's only antenna of that size. Another 210ft antenna is presently being built near Madrid, Spain; the three will support interplanetary missions from 1973 into the 1980s.

BIG $A17,000,000 DISH stands 235ft high in the hills near Canberra. Structurally complete, it is awaiting installation of electronic equipment before going into operation in 1973.

NASA has been borrowing the 210ft radio telescope built for CSIRO astronomers at Parkes, NSW, for deep space coverage from this hemisphere, and has based the design of the Goldstone antenna and both new ones on the CSIRO design.

Tidbinbilla's new antenna is as high as a 23-storey building and its 210ft dish has a surface area equal to 15 tennis courts. The shape of the dish must be maintained as a perfect paraboloid within $\pm 1/8$in, a fact which accounts for the unusually strong framework.

Like other Deep Space Network (DSN) antennas operating at frequencies of 2100MHz transmitting and 2300MHz receiving, the new antenna uses a Cassegrain cone feed mounted in the centre of the reflector.

The Cassegrain design is similar to that of an optical telescope. Signals reflected from the main dish hit a sub-reflector mounted on a truss-type support extending outward from the main dish.

The sub-reflector focuses the signal into the feed horn of the Cassegrain cone, where it is amplified by a maser.

The maser provides maximum amplification with a minimum of added noise. To minimise noise, it is immersed in liquid helium at —270°C. Signals returning from spacecraft are usually amplified about 40,000 times by the maser, then are fed to the main receiver where they are further amplified.

One of the big antenna's first jobs when it becomes operational in mid-1973 will be to take over tracking of Pioneer 10, now on its way to Jupiter. By that time next year, Pioneer 10 will be getting out of range of Tidbinbilla's 85ft (26m) antenna. The new 210ft antenna is 6½ times more sensitive than the smaller antenna.

Resources photos by rocket tested at Woomera

A Skylark rocket has been launched at Woomera to test techniques for high-altitude sensing of earth resources.

The Skylark photographed specially selected test areas in South Australia from altitudes of between 100-170 miles (170km-270km). These areas have been divided into sub-areas large enough to register on film as having a dominant terrain type.

The data gathered by the rocket will be compared with data gathered on aircraft flying at 20,000ft (6100m), and on NASA's earth resources satellite ERTS-A as well as information gathered by ground parties.

The instruments and cameras carried in the rocket have been recovered and evaluation of the data will be carried out by the University of Reading, UK and CSIRO's Mineral Physics Section, Sydney with co-operation from the South Australian Mines Department and the CSIRO Division of Soils, Adelaide.

CSIRO's interest in this experiment is a general evaluation of remote sensing techniques, with particular emphasis on their use in minerals search. CSIRO will correlate the ground, aircraft, rocket and satellite data to determine the optimum parts of the spectrum for distinguishing different terrain types at different altitudes.

A comparison of the data collected by the rocket and by the satellite is expected to indicate the optimum sun angle for recording ground features and also the best time of day for launching remote sensing rockets.

NEWS

Cartridge colour TV goes into mass production

Winner for the home video replay stakes will be decided in the marketplace. Video tape cartidges got a boost recently with the announcement that the giant US retailer, Sears, Roebuck and Co, has decided to market the "Cartrivision" system made by Cartridge Television Inc. The system, shown at right, will go on sale this month in Chicago at about $US1600.

A library of over 850 prerecorded tapes of motion pictures and other programs is already available. A full-length film will rent for about $US3-5 depending on length and content. Blank tapes and prerecorded programs will be sold by Sears for $US13.

The system includes a black-and-white video camera for "home movie" recordings and a 25in colour television console which also houses the video tape unit.

School computer project sponsored by IBM

Thirteen schools in NSW and 17 in Victoria are participating in a school computer project launched recently by IBM Australia.

Kits containing printed circuit cards, resistors, capacitors and other basic components, which make up the circuitry of a digital computer, were distributed to science teachers and pupils representing the schools concerned at ceremonies in both states.

The components, selected from IBM machines, will enable the students participating in the project to construct a small digital computer.

It is expected that schools will take an average of six months to assemble the computer, which is not designed for practical work but only to demonstrate the principles of digital data processing. It can add and subtract.

The project is meant as an extracurricular activity and not for regular class work. It is designed as a group exercise in co-operation between students interested in electronics, and those interested in engineering construction who will build the chassis for the computer.

A first and second prize will be awarded for the best machines in NSW and Victoria. The award will be based on construction, presentation, original thought in approaching the task, and the written description of assembly procedures.

Training course in sound and lighting for live theatre

A unique technical training program commenced in April when the Ensemble Theatre in Sydney began its first course in sound and lighting for live theatre. It is thought to be the first such course in Australia.

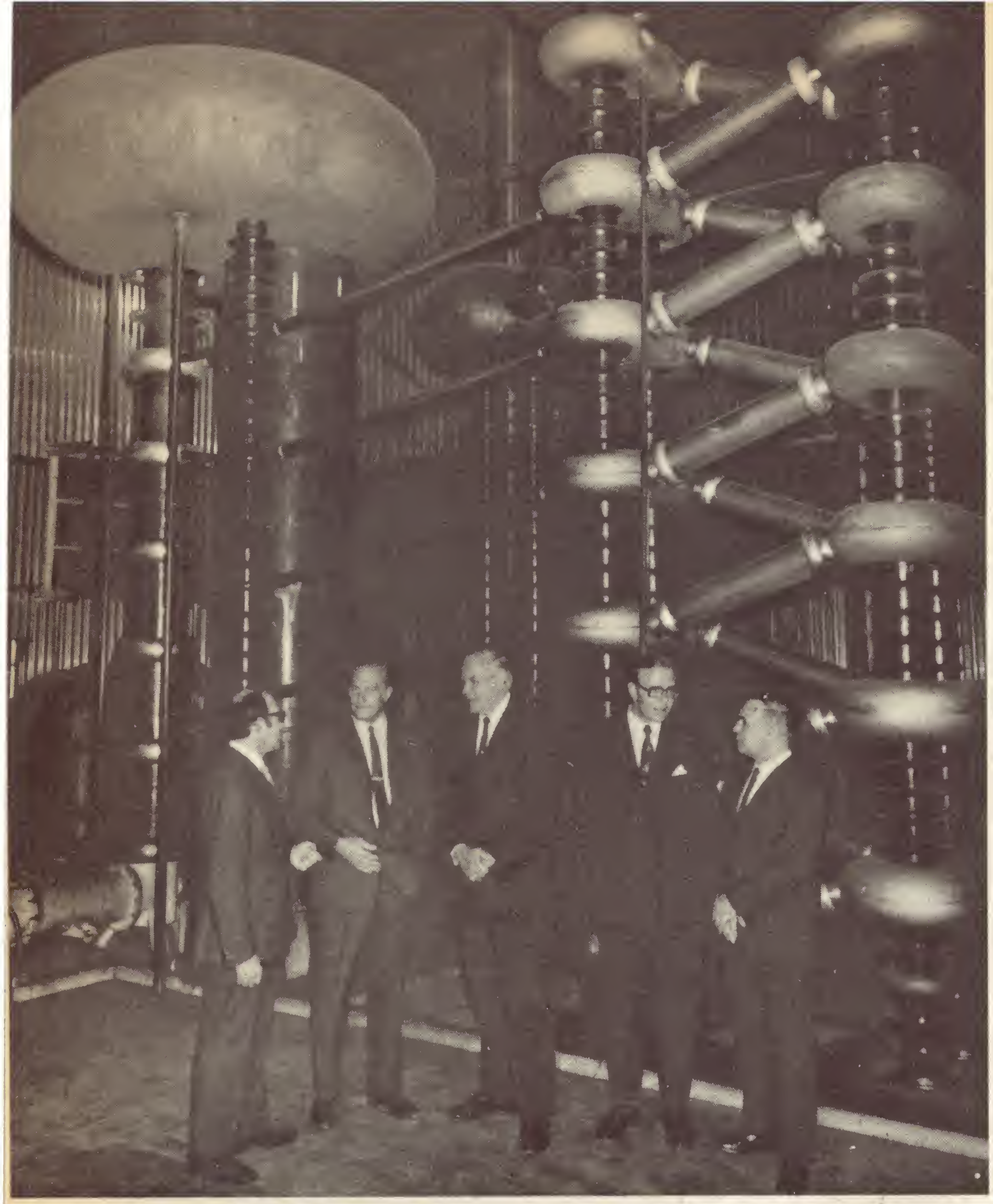
The program is first of all aimed at people who wish to make theatrical lighting and sound their profession and secondly to directors, producers and actors who wish to acquire further knowledge in this field.

The cost to students will be minimal; one third of the costs having been met by The Australian Council for the Arts and another third being absorbed by the Ensemble Theatre.

Business briefs. . .

- PLESSEY will supply a batch of a new type cartridge tape replay units for studio operators at the ABC. Three of the remarkably small-sized units, called Rapid-Q Triple-Play, housed in a single cabinet, take up less than 1 / 5 the space taken by three conventional cartridge replay units.
- STC has been awarded a $19M contract to design and install a communications network for the 258-mile natural gas transmission system operated by West Australian Natural Gas (WANG). The pipeline extends from Perth north to Dongara and south to Pinjarra.
- ZELLWEGER, manufacturer of ripple control equipment, has just opened a $¼M factory in Brookvale (Sydney). Ripple control is a system of controlling remote switching functions by injecting voice-frequency impulses into the electricity network. The company also markets police radar systems in Australia.
- DIGITAL EQUIPMENT will computerise CSR's Victoria and Macknade sugar mills, 70 miles north of Townsville. One computer will be used for direct control of the milling process and a second will be used for production control with data entered online from terminals installed in the two mills.
- RACAL announced recently that their Milgo 5500 / 96 Modems, installed at the Data Bank Centres in Auckland and Wellington, have achieved the fastest data transmission using voice frequency channels in the Southern Hemisphere. This is the first time that 9600 bits per second data transmission has been attempted over normal (300-3400Hz) common carrier circuits.

STYLISH NEW WALL PHONE will soon be available to Australian subscribers. Above, Mr H. Brooker of AWA, shows the new phone to Mr Ngiam Tong, Chairman of the Singapore Telephone Board.



Historic cascade generator (left) was switched off for the last time by Mr John Poot (second from right), Chairman of the Philips Group in South Africa, before a small audience of South African scientists. A similar generator is still in operation at the University of New South Wales after being moved there from the Australian National University in Canberra.

Rutherford's original "atom smasher" is retired

In a short, simple ceremony in Johannesburg, South Africa, in August of last year, the world's first commercially built "atom smasher" was switched off for the last time after 34 years' service in Britain and in South Africa. It is the Philips 1 million volt cascade accelerator built in 1937 for the world-famous Cavendish Laboratory in Cambridge, England. For the last six years it has been the nuclear research "work-horse" for the Nuclear Physics Research Unit (NPRU) at the University of the Witwatersrand, South Africa.

In its lifetime, it helped to open up the whole field of nuclear physics and contributed to Cavendish Laboratory's fame as a world research centre for many years. During the second world war, it was used to obtain key information for the development of the atom bomb.

The date of the final switch-off marked the centenary of the birth of Lord Rutherford, the Nobel prize winner who gave science the basic method of nuclear research used today. It was Lord Rutherford who ordered the cascade accelerator from Philips in Holland, in 1936.

Lord Rutherford was the first man to learn about the structure of atoms by bombarding them with high speed particles obtained from naturally radioactive elements. After some years he found that further research required much faster particles and some means had to be found to produce them artificially.

It had been known for a long time that charged particles could be accelerated electrically, as was done with electrons in X-ray tubes. But much greater speeds were needed than could be produced by the voltages of the x-ray apparatus of the 1930s. Two of Rutherford's assistants, Cockcroft and Walton, devised a circuit using Greinacher rectifiers stacked up in series so that the voltage was doubled for two stages, trebled for three and so on.

After small scale experimental devices of this kind had shown that the method was practical, Rutherford got Philips of Eindhoven to build a machine capable of generating a million volts and a current of several milliamperes. This machine, the first commercially built "atom smasher" was installed in the Cavendish Laboratory in 1937 and proved successful beyond all expectations. There it was in operation until 1965, when it was moved to South Africa and operated successfully until its retirement in 1971.

In the veteran machine's place, the NPRU is commissioning a Philips 2 million volt accelerator from the Diamond Research Laboratory where it has been used since 1960 on research into the effect of radiation on the physical properties of diamonds. Next year, this machine will be joined by a giant tandem Van de Graaff accelerator producing 12 million electron volt protons and higher energies for heavier ions, for example, up to 56 million electron volts for accelerated oxygen ions. This will be housed in a special building which is now rising on the campus.

The retiring machine was affectionately called the "Old Lady." Officially, it is known as "Phoenix" because it had to be rebuilt in 1961 when it was acquired from the Cavenidsh Laboratory.

Another very successful cascade generator was built for the Australian National University in Canberra on the order of Professor Sir Marcus Oliphant and it was used for many years by his successor Professor Sir Ernest Titterton. Installed and commissioned by Frank Hornman of Eindhoven and Frank Dickson of Sydney, the job took three months to the final tests.

The Canberra cascade was a seven stage generator, standing thirty feet high and had a nominal output of 1.4 million volts but was limited to 1.2 million by the lower air pressure at Canberra which is 2000 feet above sea level. Any attempt to go over this limit resulted in a spark jumping 18 feet onto the roof of the building with a deafening bang and the disruption of nearby electrical apparatus.

Like the first of its kind at the Cavendish, the Canberra cascade was not finished with the end of its time in the old home. It has now been reinstalled at the University of New South Wales and there it may well achieve as long a life as its older sister.

Fairchild Power.

Big chip silicon bimesar power. Now made in Australia by Fairchild.

Now you get more watts for your money. High power amplifiers at lower cost. Smaller lower cost heat sinks. High current, high voltage capability with low saturation voltage. Maximum safe area at high junction temperatures. Complementary pairs. And TO3, TO5, TO66 packages. For example.

Max. Power T.C.25°C	Product	Polarity	Package	LV_{CEO}	V_{CE}Sat	h_{FE}
115 W	2N3055	NPN	TO3	60	1.1 V @ 4 Amp	20-70 @ 4 Amp/4 V
115 W	AY8149	NPN	TO3	60	1.1 V @ 4 Amp	20-150 @ 4 Amp/4 V
115 W	AY9149	PNP	TO3	−60	1.1 V @ 4 Amp	20-150 @ 4 Amp/4 V
115 W	AY8150	NPN	TO3	40	1.1 V @ 4 Amp	20-150 @ 4 Amp/4 V
115 W	AY9150	PNP	TO3	−40	1.1 V @ 4 Amp	20-150 @ 4 Amp/4 V
35 W	AY8170	NPN	TO66	40	1.5 V @ 3 Amp	Typ. 30 @ 3 Amp/4 V
35 W	AY9170	PNP	TO66	−40	1.5 V @ 3 Amp	Typ. 20 @ 3 Amp/4 V
35 W	AY8171	NPN	TO66	60	1.5 V @ 3 Amp	Typ. 30 @ 3 Amp/4 V
35 W	AY9171	PNP	TO66	−60	1.5 V @ 3 Amp	Typ. 20 @ 3 Amp/4 V
25 W	2N3054	NPN	TO66	55	1 V @ ½ Amp	25-100 @ 2 Amp/4 V
10 W	AY8139	NPN	TO5	40	.6 V @ 1 Amp	Typ 45 @ 1 Amp/2 V
10 W	AY9139	PNP	TO5	−40	.6 V @ 1 Amp	Typ 35 @ 1 Amp/2 V
10 W	AY8140	NPN	TO5	60	.6 V @ 1 Amp	Typ 45 @ 1 Amp/2 V
10 W	AY9140	PNP	TO5	−60	.6 V @ 1 Amp	Typ 35 @ 1 Amp/2 V

Send for our free power brochure.

FAIRCHILD
AUSTRALIA PTY. LTD.
420 Mt. Dandenong Rd., Croydon, Vic.

The luck's on your side.

FC.4923.B

4~Channel Discs

Part 2: The CD-4. Compatible Discrete System

Last month, we discussed at some length the subject of quadraphonic discs using the matrix system of encoding and decoding. This month we take a look at an alternative approach which the proponents pointedly describe as a discrete four-channel system.

by NEVILLE WILLIAMS

Commercially, the matrix system has a lot going for it. Being a 4-2-4 system, it is equally applicable to the two-channel disc system, a two-channel tape system or to FM-stereo broadcasting. The original four-channel material can be encoded on to two channels, then replayed, dubbed or broadcast as such, and finally decoded and played back in the home, ostensibly as four-channel sound.

The frequency components involved do not fall outside the existing audio pass band, so that no special problems of compatibility are involved. Matrix-system discs can be played back with exising two-channel stereo equipment, the signal fed to a decoding unit and extra signals made available for amplifiers driving the rear loudspeakers.

Ostensibly, the matrix system offers a complete answer to the problem of obsolesence. Enthusiasts can buy matrixed quadraphonic records and play them for as long as they like on existing two-channel stereo equipment, without risk of damaging the grooves. At some later date, a decoder and additional amplifier channels can be added, and advantage taken of the quadraphonic content of the records.

At the same time the decoder provides the facility to synthesise extra signals from existing two-channel material, so that the enthusiast can gain an additional dimension from older recordings.

Reflecting the commercial attractiveness of the matrix system, it has no lack of support, at least in broad principle. To quote from a recent Japanese brochure:

"Almost all of the four-channel stereo systems available on the market today are of a matrix system . . .these are listed here for reference purposes .....

"Toshiba	QM system
Denon	QX4 system
Matsushita	AFD system
Sansui	QS system
Kenwood	QR system
Hitachi	Ambiphonic
Sanyo	QSC system
Mitsubishi	QM system
Onkyo	X—1 model
SONY	SQ system
TEAC	A—2400 model
Pioneer	Quadrilizer"
JVC / Nivico	SFCS

This list does not include manufacturers in countries other than Japan, nor does it reflect the backing for the system from companies marketing complementary discs and tapes.

But, as we pointed out last month, for all its convenience and attraction, the matrix system falls short in one vital area: it is not a true four-channel system nor, presumably, can it ever be.

It suffers intrinsically from cross-talk between channels, and individual companies have sought to offset this limitation with all manner of electronic processing. Whatever the final decoding system recovers, it certainly cannot recover four original and discrete channels from a two-channel medium.

While the limitations of the matrix system will obviously have been well known to recording engineers, the implications of their mathematics and their rather obscure circuitry have not been readily apparent to the majority of technical writers. The loudest message has been the commercially inspired one that the four-channel disc problem had been solved by the matrix system (albeit rather mysteriously) and that it was all over bar the shouting!

Gradually, however, the contrary opinion has filtered through, along the lines expressed in our last issue — though not in anything like as much detail.

A recent issue of J.E.I. (Japan Electronic Industry magazine) carries an article headed: "4-Ch. Stereo Systems Pushed Strongly, But Lack True Definition, Development".

Discussing the subject, the writer says: "Among the records already on the market, those with more echo components and recordings of actual performances may well be called the matrix records, because most matrix records are more befittingly described as variations of two channel records, rather than four-channel records".

One of the companies which has taken a strong contrary line in the four-channel arena is JVC / Nivico — JVC standing for Japan Victor Company. In a recent publication, one of their writers says:

"Separation is incomplete in a matrix system. Thus a 4-channel record is not very different from a prior stereo record. It is advantageous from the standpoint that a conventional stylus and cartridge can be used without modification. However, it has a problem in the complete separation of the four sounds, which is the most important requirement for 4-channel stereo systems. It is not possible by the matrix system to pick up one sound alone."

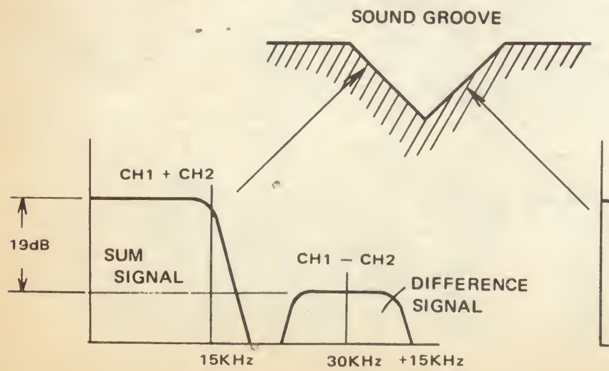


Fig.1: The CD-4 system uses the basic geometry of two-channel stereo but records signals up to 45kHz on each groove wall. This allows two distinct signals to be virtually "stacked" on each wall, one recorded directly at audio frequencies, the other modulated on to a 30kHz carrier, as shown at left.

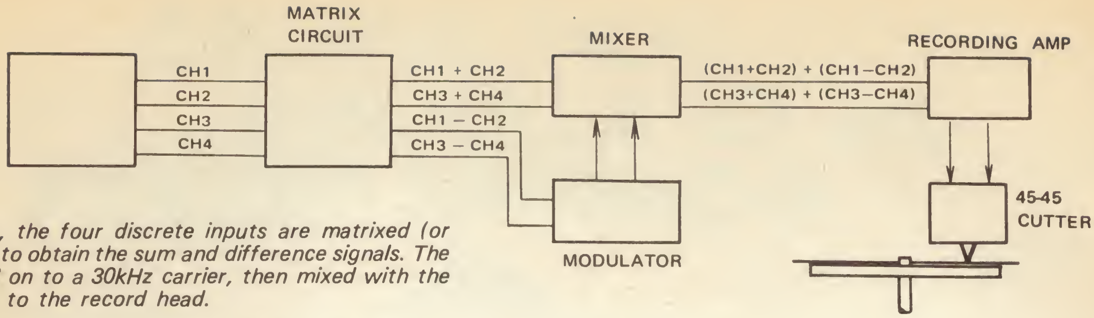


Fig.2: For recording, the four discrete inputs are matrixed (or combined) as shown to obtain the sum and difference signals. The latter are modulated on to a 30kHz carrier, then mixed with the sum signals to feed to the record head.

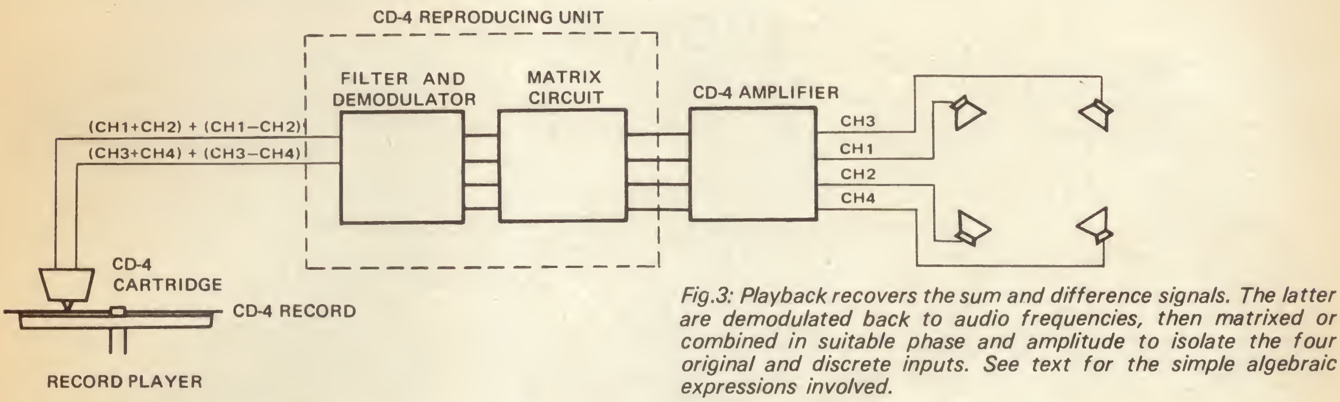


Fig.3: Playback recovers the sum and difference signals. The latter are demodulated back to audio frequencies, then matrixed or combined in suitable phase and amplitude to isolate the four original and discrete inputs. See text for the simple algebraic expressions involved.

JVC has, in fact, done the lion's share of research into systems which hold real promise of a true four-channel capability — as expressed in the capacity of a system to produce sound from any one of four loudspeakers in isolation, or from any number of those loudspeakers in any desired proportions.

With four-track tapes it is no great problem. With discs it is a problem because, fundamentally, a stylus can only respond reasonably to two vector forces, displaced from each other by 90 degrees. It is a question of making those two vectors do four jobs.

The system finally adopted by JVC assumes the use of a normal stereo groove, with each wall at 45 degrees from the horizontal. However, instead of each wall carrying just one audio signal (right channel or left channel) each carries two distinct signals, impressed simultaneously by the recording cutter. But unlike the matrix system, they do not share the same frequency band.

One of the signals is at audio frequencies in the range nominally between 30 and 15,000Hz.

The other, having first been frequency modulated on to a 30kHz carrier, occupies a range of frequencies between 20,000Hz and 45,000Hz — ie 20 to 45kHz. To invoke an old PMG term, they are "stacked" in terms of frequency.

Each wall of the groove thus carries a complex pattern of frequencies ranging from about 30Hz to about 45kHz, representing the content of two separate and distinct audio signals. Between them, the two groove walls carry information about four separate audio signals. (see Figs 1 and 2).

The playback cartridge can be designed along broadly conventional lines but it must be capable of responding to this very wide frequency range without prominent peaks, troughs or resonance effects. In broad terms the frequency capabilities need to be about two-to-one up on existing high quality stereo cartridges.

The complex pattern of frequencies recovered by each half of the cartridge is fed to a frequency dividing network. (Figs 3 and 4).

Frequencies in the range 30Hz to 15kHz are separated out, to become one of the signals originally fed to the corresponding coil of the recording cutter.

Frequencies in the range 20kHz to 45kHz are likewise separated out, fed to an FM demodulator, and thus used to recover the second signal fed to that cutter coil.

From the two groove walls and from the respective halves of the cartridge, four separate signals are thus obtained.

At first glance, one might assume that the stereo signals for the front loudspeakers would be recorded on the respective walls as the basic audio component. Further, that the stereo pair for the rear loudspeakers would be impressed on the 30kHz carriers. But in fact, for a variety of reasons, JVC have chosen not to do it this way.

Instead, they matrix (or combine) channel 1 and channel 2 together and inscribe the resultant "sum" signal as the basic audio pattern on one wall of the groove. Channel 3 and channel 4 are inscribed on the other wall. The logic of this approach is not hard to discover.

If we assume that channel 1 is front left and channel 2 is rear left, the sum of the two (Ch.1 + Ch.2) representing the total left signal ends up as the basic audio pattern on one wall of the groove.

Similarly, the total right-hand signal ends up as the basic pattern on the other wall of the groove.

If played on a two-channel stereo system, the disc is heard as a two-channel stereo disc, with normal separation between left and right but, of course, with front and back combined.

If played in mono mode, the components add again, to produce a normal mono signal.

What of the high frequency components, which are also inscribed in the groove walls?

Very simple.

The majority of styli and cartridges will not respond to them very effectively, and they will be further attenuated by the normal de-emphasis and tone control circuitry. What is left, still has to get through the loudspeaker. Last but not least, frequencies above 20kHz are outside the range of hearing anyway!

In this respect, therefore, the discs can be accepted as playable on, and compatible with, existing stereo and mono equipment.

What is actually modulated on to the two high frequency carriers is the "difference" between the respective pairs of signals. The same groove wall which carries (Ch.1 + Ch.2) as a direct audio signal, also carries (Ch.1 — Ch.2) modulated on to its 30kHz carrier.

In four-channel mode, it is necessary to recover and demodulate the 20kHz to 45kHz components to isolate the audio difference signal (Ch.1 — Ch.2). Then by adding samples of the sum and difference signals in suitable amplitude and phase, the individual components can be recovered. The algebra is very simple:

$(Ch.1 + Ch.2) + (Ch.1 - Ch.2) = 2 \times Ch.1$

Again:

$(Ch.1 + Ch.2) - (Ch.1 - Ch.2) = 2 \times Ch.2$

In short, the Channel 1 signal and channel 2 signal can be recovered, substanitally in their original form.

The same applies to channels 3 and 4.

Because it is theoretically possible by these means to record and recover four completely separate audio signals, JVC have called their system "CD-4" standing for "Compatible Discrete 4-Channel".

The various steps in the CD-4 system are illustrated in the accompanying diagrams,

NOW AVAILABLE: JVC CD-4 DISCRETE 4-CHANNEL RECORDS

World's first discrete 4-channel records now at all JVC dealers
Hear Bizet's fiery *Carmen Suite* and your favorite themes from the movies like you've never heard them before at your nearest JVC dealer. These are the first in many planned JVC discrete 4-channel record releases in the coming weeks and months. Your dealer has all the facts on the records and on the simple add-on equipment you'll need to hear them. If you can't find a JVC dealer in the phonebook, write to the nearest JVC distributor listed below for your dealer's name and address.

The missing link in 4-channel sound
Until now the only discrete 4-channel sources available were tapes and cartridges. Prohibitively expensive in themselves for most people, these sources also required special 4-channel decks for playback. The discrete 4-channel disc—the biggest 4-channel source of all—was missing. Today, thanks to JVC, this is no longer true.

Big breakthrough in recording
How to put four separate signals on the walls of the standard v-shaped record groove while maintaining the same tonal quality and price factor of existing 2-channel records was a major obstacle to the development of the 4-channel record. JVC solved it by major breakthroughs in the record cutting process. So far, some ninety patents have been applied for in the JVC CD-4 system. Some of the breakthroughs include a modulated recording system, low speed cutting, carrier level control, Neutrex process, automatic noise reduction system and new Shibata stylus.

For your free booklet write to:—

Hagemeyer (Australasia) N.V.
P.O. Box 49,
Kensington, N.S.W. 2033

Discrete 4-channel sound
Discrete, by definition, means that where a plurality of sound transmission systems is present, each transmission system is independent. This is the JVC CD-4 system. It gives the kind of separation which makes it possible to orientate sound to a required location. And to reproduce the original musical properties recorded. And to give the listener more freedom in movement in listening to the music. Matrix-type or encoded 4-channel systems do not have this complete separation. Which means that no matter how sophisticated, they just can't qualify as real high fidelity systems.

Equipment needed
Other than a basic 4-channel reproducing system and quality turntable, the only equipment you need to hear JVC discrete 4-channel records are the JVC 4MD-10X 4-Channel/2-Channel Playback Cartridge and JVC 4DD-10 Disc Demodulator. This equipment is now available at all JVC dealers.

JVC NIVICO

4 CHANNEL STEREO

CD-4 SECTION, AUDIO EQUIPMENT DIVISION, VICTOR COMPANY OF JAPAN, Shimotsuruma, Yamato City, Kanagawa Pref., Japan
VICTOR COMPANY OF JAPAN, LIMITED, 1, 4-chome, Nihonbashi-Honcho, Chuo-ku, Tokyo, Japan
Distributor: Hagemeyer (Australasia) N.V. 59 Anzac Parade Kensington N.S.W. 2033
Branch Offices: Melbourne, Adelaide, Brisbane, Perth, Lae, Rabaul, Port Moresby, Madang

which should be studied together with the explanatory captions.

While the foregoing sets out the basic principles of the CD-4 system, a perusal of JVC literature points up numerous refinements in detail and approach which represent the difference, no doubt, between a basic concept and a commercially acceptable end result.

A single master oscillator is used as the high frequency source. Its output is split and each signal passed separately through a "Serrasoid Frequency Modulator", for the respective groove walls. This and other precautions in the modulation and demodulation process are aimed at minimising the generation of spurious beats between the respective high frequency signals.

Special attention is paid, not just to the deviations of the recorded groove, but to the path which is likely to be traced by a spherical-shouldered playback stylus. This must be related in turn to amplitude and frequency, and also to wavelength, as affected by the diameter of the particular groove.

To this end, the signals on the master tape are read by separate heads just ahead of the heads which feed the recording stylus. These pre-record signals are analysed from instant to instant, correlated with the groove diameter and used to modify dynamically the input to the cutter. It is, in fact, an extension of the long established JVC / RCA Dynagroove technique.

JVC stress that it is necessary to minimise tracing aberrations, both to minimise distortion as such and to preserve optimum phase relationships in the high frequency modulation components. Also at stake is the matter of intermodulation and cross-talk which can be deteriorated by non-linearities in the system.

JVC diagrams indicate the use of FM pre-emphasis, compression and expansion, and muting — all ostensibly aimed at achieving the highest possible signal / noise ratio.

Interestingly enough, the master disc is cut at less than half speed, with master tape speed and master oscillator frequency scaled down in proportion. This is regarded as an interim technique, however.

In all, something like 90 patents have been taken out on various aspects of the system.

Draft standards have been presented to the Japan Record Association, to the EIA and RIAA in the USA, and to the European DIN Standard Committee, with a view to encouraging the adoption of the CD-4 system as a world standard.

JVC specifications claim that it is applicable to 12in, 33rpm discs and 7in 45rpm, if need be. Frequency response of each channel is claimed to be 30Hz to 15kHz, cross-talk between channels better than 25dB, and signal / noise ratio better than 50dB. These figures apply to what is on the disc and to be realised in practice, assume the use of a suitably high quality stylus, cartridge and demodulator / decoder.

While Panasonic / National and RCA gave the CD-4 system their formal blessing and cooperation, JVC / Nivico was the first to move it into the commercial sphere with the release of about fifteen albums in mid 1971 straddling the range from rock to classical.

At a press conference in New York, about the same time, the President of RCA Records, Rocco Laginestra, acknowledged

MATRIX SOUND IN THE LISTENING ROOM

It's all very well to talk about the theory of matrix type quadraphonic sound and to discuss its merits and de-merits relative to the CD-4 system described in these columns. But how does the matrix system actually sound in the home? Is it likely to satisfy listener requirements?

The differences between the matrix system and the discrete system have been explained in detail. Time alone will tell whether industry and the public will opt for the convenience of one or the theoretical superiority of the other.

While I have been writing these articles, I have been living alongside a system assembled temporarily from components submitted recently for inspection:

RECORDS: Astor 4-channel, as advertised last issue, page 40. Also pre-release pressings from Festival, from the Enoch Light stable.

The Onkyo amplifier has facilities for adjusting left-right balance and front-back loudness. By using the controls to isolate the sound sources, the normal left-right frontal stereo content is obvious. What comes from the rear loudspeakers is much closer to a mono signal, but lacking a firm image — doubtless due to manipulation of the relative phases.

The overall result — which is what really matters — is a room filled with sound. No matter where one sits, there is a sense of dimension, without, however, a strong sense of direction. It is a pleasant effect, if not very

CARTRIDGE: Empire 1000ZE / X as reviewed in March, 1972. This is a very good cartridge indeed.

PLAYER: Garrard Zero 100, reviewed in April, 1972. Tracks and operates quite happily at 1 gram, even with warped discs. Lives up to its specifications in everyday use.

AMPLIFIER: A new model, the Onkyo 4-channel Surround Stereo Receiver Y-3A, as pictured. It has an in-built matrix to cope with quadraphonic matrix discs or to simulate four channels from two. It was made available to us by Dodwell Trading Pty Ltd, 8 Glen St, Milsons Point, 2061.

LOUDSPEAKERS: Four good quality bookshelf-size units.

Having, for some time, lived with simulated 2-4 quadraphonic achieved purely with additional loudspeakers, I found it interesting to compare those results with what is obtainable from the abovementioned system.

I can state without equivocation that the spread of sound from the matrixed recording and system is well ahead of what can be achieved by 2-4 simulation. The rear signal is full bodied and one which could be listened to in its own right.

definitive. My tip is that the majority of listeners will clearly prefer it to two-channel stereo, just as they have preferred two-channel stereo to mono.

Could it suffer by comparison with the CD-4 system? In terms of definition, yes. But do listeners really want to be assailed by discrete sounds from any quarter of the compass? Are they going to react to atmosphere or technology?

If atmosphere, the matrix can provide it. If technology, then the CD-4 system will win.

And what of the Onkyo 4-Channel Surround Stereo Receiver? Well we didn't put an instrument near it; we simply took it home and used it as described!

It worked fine. Adequate gain and power output, no noise or hum, simple to operate, and with all controls doing exactly what they were supposed to do. It did a good job simulating four channels from two, yet it also provides four inputs to cope with signals from a discrete tape system or a CD-4 decoder / demodulator.

For good measure, it provided a fine AM tuner and a stereo FM tuner, although sad to say the latter is wasted in this country. Recommended retail price of the Y-3A is $319. (W.N.W.)

"phenomenal progress" during the preceding few months and indicated that RCA was involved in concentrated research which should lead up to its own launch in the near future.

Panasonic was in much the same situation.

In fact, the RCA marketing effort is now rolling and, by the time this issue is in the hands of readers, four-channel discrete records carrying the RCA label should be on sale in American record shops.

RCA's marketing ultimate plan is to release new records only in the CD-4 format, thereby eliminating the need for double stock inventories. They would be played in mono, two-channel stereo or 4-channel stereo, according to the buyer's own equipment.

Despite the confidence and influence of the JVC / RCA / Panasonic group, the CD-4 type of disc yet has to prove its commercial superiority over the simpler, though less ambitious matrix type.

In two areas at least, it faces an obvious disadvantage. CD-4 discs cannot, as yet, be broadcast directly over stereo / FM stations, because the frequency content exceeds what can be contained in the authorised spectrum.

Again, the CD-4 signal cannot be handled by ordinary audio circuits or dubbed for ordinary 2-channel tape replay, because of its 45kHz bandwidth.

Of more immediate importance to high fidelity enthusiasts is the durability of the high frequency signals inscribed in the groove.

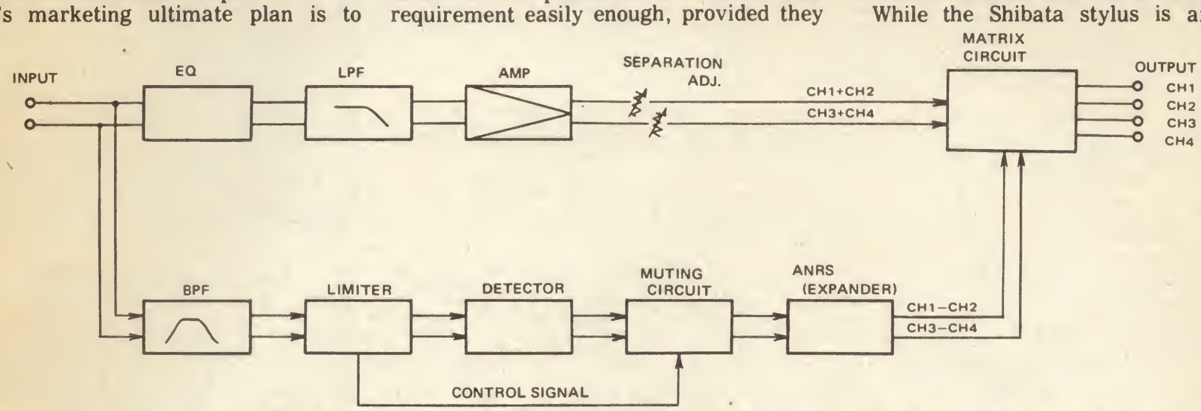


Fig.4: The essential elements of a CD-4 demodulator unit. Output from the pickup is fed into the input terminals, left. Audio components, representing the sum signal pass through a low pass filter (LPF), while the difference signals have to be separately demodulated and processed. They are finally combined in a matrix to produce 4-channel discrete channels.

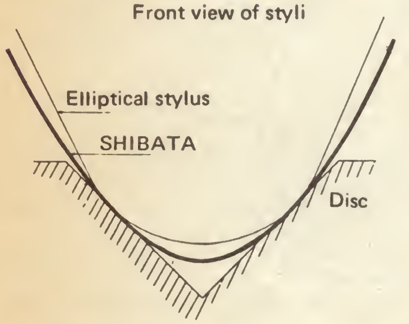


Fig. 5: Viewed from the front, the shoulders of the Shibata stylus have a larger radius of curvature than the conventional elliptical or bi-radial type. Pressure per unit area is reduced, as also is stylus and groove wear.

How may times can CD-4 grooves be played with suitable equipment before the fine serrations become noticeably degraded?

What will happen to a CD-4 disc if it is played even once with a too-heavy, not-very-compliant cartridge? Will the vital difference signal simply be obliterated?

JVC state that research has shown that the average LP disc is played about 20 to 30 times. They appear to be confident that their current production will meet this requirement easily enough, provided they are played with a suitable cartridge and at a playing weight no greater than 2 grams.

They stress, however, that the records can be damaged by older and heavier cartridges. The "sum" signals would remain as normal stereo, but the "difference" signals, necessary to re-create the rear channels, would be at hazard.

One of the reasons for RCA's hesitancy was reportedly their need to be assured that the records would be good for at least 100 playings under proper conditions, and less liable to damage in other circumstances.

RCA's answer seems largely to be in the choice of a new and harder grade of vinyl. Supply and processing problems had to be straightened out but the new vinyl is now said to be giving much harder pressings with lower noise than the standard item.

When teamed with a new decoder developed by Lou Dorren of Quadracast Systems Inc, of San Mateo, California, the new records are credited with adequate difference signals even beyond 100 plays.

And, finally, JVC research into the CD-4 technique has produced a new type of stylus, which is claimed to represent a notable improvement on the current elliptical or bi-radial types.

In these conventional types of stylus the combination of the two effective radii produces a minimum area of contact between the stylus shoulders and the groove walls. However, this produces wall deformation which can exceed the elastic limit of the vinyl with playing weights in excess of 2 grams.

In addition, it is claimed that the depth of penetration of the shoulders into the wall modifies the mechanical impedance of the system and makes it that much more difficult to achieve extended frequency response.

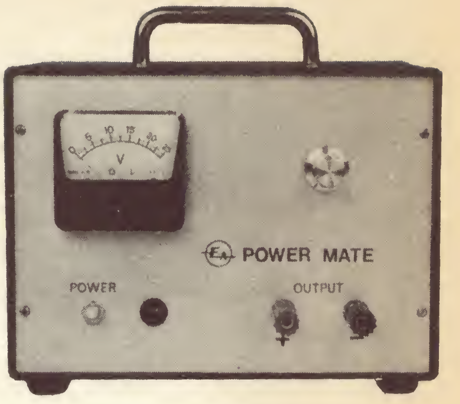
The new "Shibata" stylus still has small radius shoulders, in order to trace more effectively the smallest wavelengths in the groove wall. However, viewed from the front, the Shibata stylus is more pyramidal in shape, with a larger effective curvature of the surfaces resting against the walls parallel to the modulation (Fig. 5). JVC claim that the effective area in contact with the groove wall is multiplied by four times, resulting in less deformation and much lower wear of both record and stylus.

In addition, they claim a marked improvement in frequency response and a reduction in cross-talk characteristics.

While the Shibata stylus is aimed at solving problems in the region above about 15kHz, it will be interesting to see whether it will have an impact on the ordinary two-track stereo market.

But, of course, the big question is not the Shibata stylus. It is the CD-4 system itself. Will the hi-fi fraternity insist on true four-channel capability or will it settle for something somewhat less pretentious? The matrix system, for example?

Variable regulated supply using new IC



Here is a new variable regulated power supply which would be ideal for experimenters, service technicians and development engineers alike. Although very simply built and low in cost, it offers a standard of performance normally found only in costly commercial supplies. Heart of the unit is a new power regulator IC from Motorola.

by GEORGE HUGHES

A variable low-voltage power supply is almost essential for servicing, experimental or development work on solid-state circuits. And if the work is at all serious, the supply should ideally be regulated — ie, once the output voltage is set to a certain figure, it should be maintained as closely as possible despite changes in the current drawn by the load circuit and the voltage of the power mains.

Until only a few months ago, such power supplies have tended to be fairly complex, and relatively costly — see, for example, our Lab-Type Power Supply of September 1968. But the complexity and cost barriers have now been broken with the development of new power regulator integrated circuits such as the MC1469R device recently released by Motorola Semiconductors.

Although it costs only a few dollars, the MC1469R provides just about all of the circuitry needed to produce a high-performance variable regulated supply: reference source, comparator, regulator, current monitoring and overload protection, and provision for remote sensing. Apart from the IC itself all that is basically needed is a power transformer, rectifier and filter electro, together with a few minor components including a pot to adjust the output voltage!

As you can see from the circuit diagram, we have actually taken the idea a little further than this. Our supply incorporates such additional niceties as a case, a power switch and pilot lamp, some terminals and a low-cost meter to monitor output voltage. The resulting unit is still very simple and easy to build, and costs a fraction of the price of comparable commercial supplies.

How well does it perform? Here are the figures. Output voltage is adjustable from 3.5V to 20V, the maximum being determined by the power transformer we were able to use, rather than the IC. Maximum output current for regulated output voltage is 400 milliamps at 15V output and below. Above 15V output the maximum current for good regulation falls below this figure, again largely because of the power transformer.

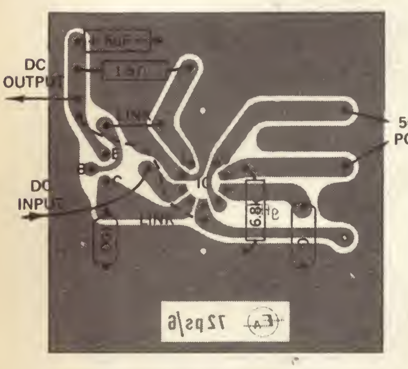
Voltage regulation at 15V for full 400mA loading is .03%, a figure which compares very favourably with many high-priced commercial supplies. Regulation at 10V is almost as good, at .04%. Below this the performance drops slightly, but at 5V output it is still better than 0.2%. These figures are for 240V mains input, but even with our DVM we were not able to detect supply output voltage variations when the mains input was varied up and down by 10%.

The supply is overload and short-circuit proof. At a current level a little above 400mA it changes smoothly into a constant-current mode, the voltage falling to zero at about 430mA. It is therefore ideal for bench-top use, where the output can often be shorted by leads touching or the connection of faulty equipment. Current sensing for the protection function is performed by the 1.5 ohm resistor and the BC107 transistor.

Ripple output of the supply is low. At load currents of 150mA and below it is less than 0.6mV, while at full load of 400mA at 15V output and below it is still less than 2mV. At ouput voltages above 15V the ripple rises above 2mV for load currents above 200mA, but this is due to the drooping regulation of the power transformer.

The supply is housed in a small instrument case. For the prototype we used one of the vinyl covered "ATC" cases available through Watkin Wynne Pty Ltd, measuring 7in x 5in x 4in (178mm x 125mm x 100mm). Other ready-made steel or diecast cases would be equally suitable.

The MC1469R uses high-gain silicon transistors, and thus like other linear ICs it tends to be a little critical of wiring layout. A poor layout can result in serious instability problems. For this reason we have designed the main section of the supply on a printed wiring board, and we strongly suggest that you build up the supply using a board made from our pattern. Ready-made boards should be available shortly via the usual suppliers, or if you wish to make your



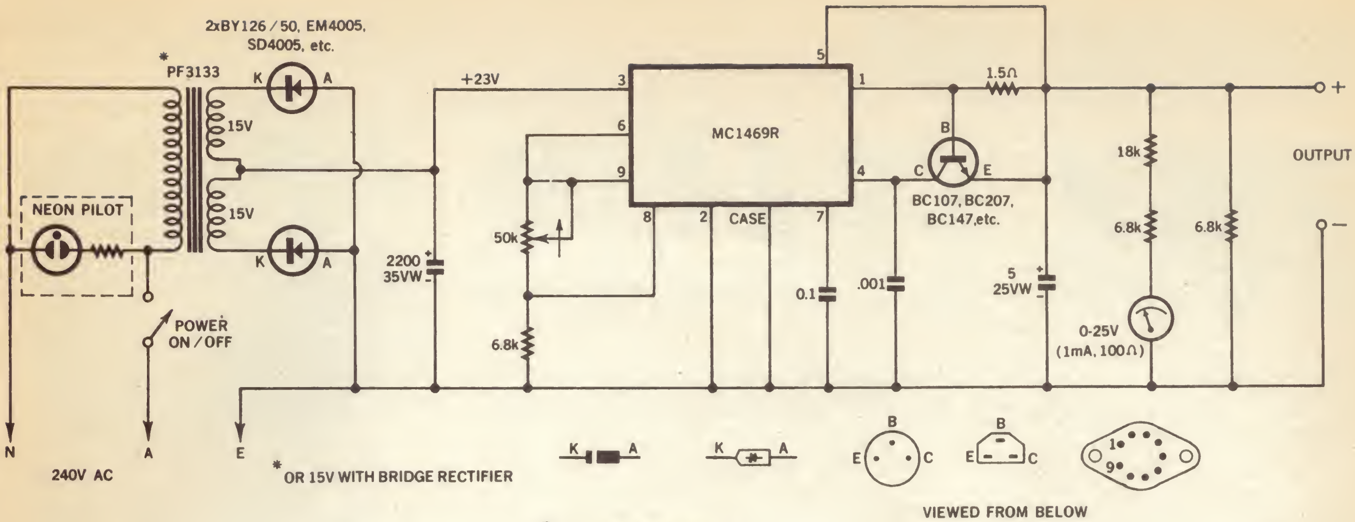
Apart from the transformer and rectifier, most of the supply wiring is on this small printed wiring board. The board is supported by the power IC, which is mounted on a heatsink bracket as shown in the photograph on the opposite page.

THE PARTS NEEDED TO BUILD IT

- 1 Instrument case (see text).
- 1 Power transformer, 30V CT at 500mA or more.
- 1 MC1469R integrated circuit (Motorola).
- 1 BC107, BC207 or BC147 transistor.
- 2 BY126-50, SD4005, EM4005 or similar silicon diode.
- 1 Neon indicator bezel.
- 1 Small instrument knob.
- 1 Miniature single pole ON/OFF toggle switch.
- 1 Printed wiring board, 72/ps6.
- 1 0-1mA meter, preferably with "0-25 volts" scale.
- 1 50k potentiometer, linear.
- 1 18k ½watt resistor
- 3 6.8k ½ watt resistors
- 1 1.5 ohm ½ watt wirewound resistor.
- 1 2200uF 35VW electrolytic capacitor.
- 1 5uF 25VW electrolytic capacitor.
- 1 0.1uF 25V ceramic capacitor.
- 1 0.001uF 25V ceramic or polystyrene capacitor.
- 2 terminals, 1 red, 1 black.
- 1 Mains lead with 3-pin plug, cable clamp.

Tagstrips or tagpanel, nuts, screws, spacers (⅛in Whit or 6BA), hookup wire, rubber feet, carrying handle, rubber grommet, scrap 18 gauge aluminium for heatsink, etc.

Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.



POWER MATE

The circuit diagram above shows how simple the design of a regulated variable supply becomes when the MC1469R IC is used. Note that pin 5 of the IC may be used for remote sensing if required.

own, actual size transparencies are available via the Information Service for 50c. Quote the code number 72/ps6.

All but the power transformer and rectifier assemblies are mounted on the front panel. As can be seen from the photographs, the IC heatsink, a piece of 18 gauge aluminium suitably shaped, is mounted on the front panel by the meter mounting screws on one side, and the potentiometer mounting bush the other side. The circuit board is mounted clear of the heatsink almost to the full length of the IC pins by 6BA screws passing through each mounting flange hole of the IC, heatsink, and board, with suitable spacers or nuts on each screw. Once in position, the IC connections to the board are soldered.

We have used a Ferguson PF3133 transformer, a stock type which has a 30V centre-tapped secondary and a rating of 500mA. With a full-wave rectifier using two BY125/50 or similar diodes as shown, it delivers between 21 and 23 volts output for the regulator IC using the 2200uF reservoir capacitor. Other transformers may be used, providing they are capable of delivering 500mA or more and have a voltage of not more than 20V RMS per side (ie, 40V CT).

It would of course be possible to use a transformer with a single untapped secondary, with a bridge rectifier circuit. Here again the transformer should have a rating of 500mA, or more, and a voltage of no more than 20V RMS.

Although the MC1469R has provision for remote sensing, this facility would not really be in keeping with the concept of a simple general-purpose supply, and for this reason we have elected not to use it. We have brought the remote-positive sensing input of the IC out to a separate conductor on the wiring board, but this is simply linked across to the positive output.

Those who would like to "gild the lily" could provide the remote sensing facility by bringing the IC sensing input out to a front panel terminal. This would normally be linked to the positive output terminal, and only disconnected when it is necessary to run a separate lead to the load to compensate for the voltage drop in long leads.

But note that in order to achieve full remote sensing, it will also be necessary to isolate the IC heatsink from the case of the supply, and bring the "negative" line on the wiring board out to its own front panel terminal separate from the negative output of the rectifier. Again the two negative terminals would be linked together normally, and only separated to permit the negative IC line to be taken directly to the load to compensate for losses in a long negative lead.

Natually if this were done, the insulated IC heatsink would also allow the output of the supply to be "floated" with respect to earth.

Components mounted on the wiring board should be wired close to the board, particularly the smaller capacitors. Other connecting leads should be as long as necessary to make each connection comfortable, but not excessively long. If these points are observed, no problems with instability or oscillation should be encountered.

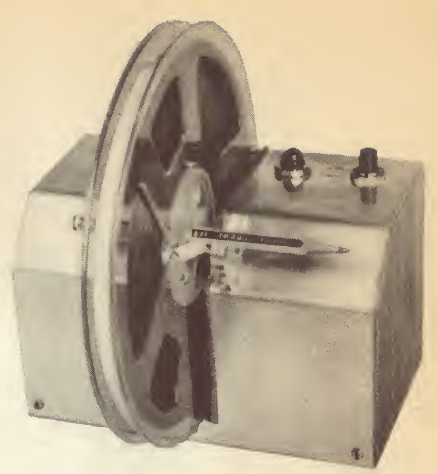
The remaining sections of wiring can be readily assembled on tagstrips or tagpanels. These include the rectifier and filter system, mounted within the body of the case. The series meter multiplier resistors may be strung in series between the appropriate points, as shown in the photograph.

At right is the supply opened to show the basic rectifier inside the case, and the way the printed board is supported by the IC and its heatsink bracket.

If using the ATC case, place the power supply parts as close to and right across the back to provide sufficient clearance for the wiring mounted on the front panel.

Well, there you have it. A very easily made little power supply, and one which will not cost nearly as much as a comparable commercial unit. If carefully built, it should prove a real asset to any service shop or experimental bench.

MAGNETIC TAPE
BULK ERASER



Here's a useful accessory for the tape recording enthusiast — a bulk eraser which will accept 5 inch and 7 inch spools of standard ¼ inch magnetic recording tape. It can be built around two modified filter chokes or small power transformers, and operates from the AC mains.

by GEORGE HUGHES

As every tape recordist knows, one of the best characteristics of magnetic tape over any other recording medium is its erasibility.

Tape is erased by subjecting the magnetic material to an alternating or permanent magnetic field of sufficient strength to destroy any previous pattern.

The permanent magnet method of erasure is the simplest, but is usually used only on the very cheapest recorders.

The alternating field system uses a separate head, similar to the recording head, but with a much wider gap. While recording, this head is excited by a high frequency power oscillator at, typically, 40-100KHz. The oscillator power, about 1 watt, produces a flux of sufficient strength to erase any previous recording. The erase head is placed before the recording head in the direction of tape transport.

Since recorders are already equiped with erase facilities, why use a bulk eraser?

There are several reasons. In normal use, a tape will collect a whole range of items, many of them irelevant, personal, or even confidential. If, subsequently, the tape has to be passed into someone elses care, but only part of it contains relevant material, there is the problem of how to erase the remainder.

While it can be done by simply running the tape through the machine in the record mode, with no signal input, this can be a tedious operation, particularly with a large reel of tape and a four track system.

With a bulk eraser, the whole tape can be wiped clean in a few seconds before the vital recording is made.

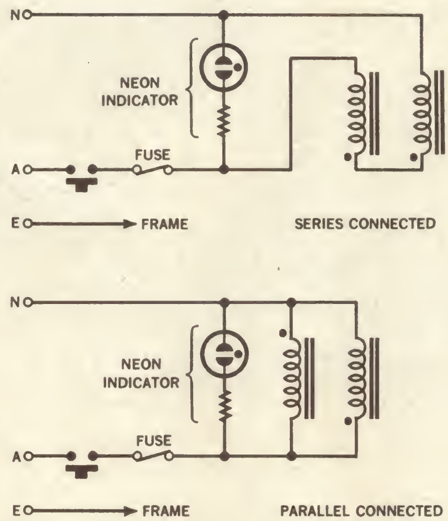


Diagram showing either series (upper) or parallel (lower) connections for the eraser coils. Dots denote abitrary ends of coils, either start or finish, assuming both coils are wound in the same direction.

Again, there is a possible problem when tape is transferred from one machine to another. Unless the alignment of both sets of heads is the same it is quite possible that a recording made on machine No 1 may not be completely erased, for example, along one edge, when a new recording is made on machine No 2. If subsequently replayed on machine No 1, or a machine with similar alignment, a background of the old recording would appear behind the new one.

Fairly obviously, bulk erasure, before transfering to machine No 2 would avoid any such problem.

Finally, there is the problem of noise. While not usually a serious problem, there is little doubt that a tape which has been recorded and erased a number of times will have a marginally higher noise level than the first recording on a virgin tape, since there are many factors which will influence this, such as the grade of tape, the optimisation of the bias level and frequency, etc, it is impossible to forecast just how serious the problem will be in any one situation. Suffice it to say that, where the very best results are required, bulk erase would seem to be good insurance.

In essence, a bulk eraser is an AC electromagnet whose field is strong enough to overcome any premagnetised pattern of oxide particles on a tape, and to leave them in such a random condition that the tape possesses no resemblance of a previous magnetic pattern.

Commercial bulk erasers use a large multi-turn coil, usually connected to the 50Hz mains, with provision to mount the reel of tape in close proximity to it and to rotate it.

A good substitute for such a special coil is a pair of modified chokes or transformers. By adopting a "staggered" layout of the two windings it is possible to use relatively small units and still cover a 7in (177mm) reel of tape.

A cheap bulk eraser can be made with two such windings, a few pieces of wood, some 18 gauge aluminium, a press-button switch, a neon indicator, and a length of 3-core power flex and plug.

Our eraser used a pair of CF396 Ferguson filter chokes, modified by removing the "I" section of the core. (See photo.) Whatever units are used, they will have to be modified to this configuration.

Removing the "I" section provides an open magnetic circuit, allowing the magnetic field to pass through the tape in the final set-up. It also reduces the inductance and increases the current flow. While the increased current flow is desirable, there is a limit set by the tendency for the coils to overheat. Whatever units are finally chosen, their suitability, and the method of connecting them, will be determined by the heat generated during a typical duty cycle.

Before spending money on new components, we suggest you "scrounge" for suitable windings, as components as large as are needed are not cheap when new. Windings extracted from TV vertical output transformers, small power transformers, vibrator transformers, etc, will be suitable with proper interconnection of their windings.

The core size should not be less than a 1in (25mm) thick stack of 1in "wasteless"

lamination, in order to cover the full width of a 7in spool.

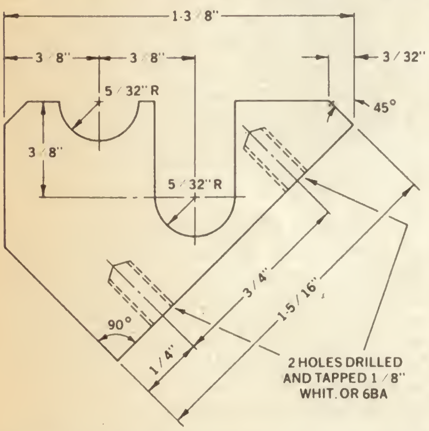
(A "wasteless" transformer lamination is one where the winding spaces in the "E" equals the width of an "I". The size of an "E" lamination refers to the tongue width, which is twice the width of the winding spaces. For a 1in wasteless lamination, the width of the "I" will be ½in, and its length will be 3 inches. Thus, a transformer lamination size can be gauged by its longest edge).

Armed with the above information and a steel rule, it shouldn't be hard to find two suitable items. Try to find two of the same type if possible.

As a guide, windings with not less than about 2000 turns should be satisfactory. Small power transformers would probably have sufficient turns when all windings are connected in series. Assuming a design figure of 5 turns per volt, a 240V primary will have 1200 turns, and a 150V per side HT winding will yield a further 1500 turns. Total, 2700 turns.

To correctly series-connect such windings, connect the primary to the ends of a length of power lead terminated in a suitable terminal block. Connect one end of the HT winding to one side of the primary, and the other end to a spare terminal to keep it away from other wires.

Plug into a 240 volt outlet and switch on. Measure the AC voltage from the free HT terminal to the remaining 240 volt terminal. If correctly connected, the voltage right across the two windings should measure 240 volts plus the HT nominal voltage. If less



Detailed drawing of the lugs to be mounted either side of the slot. A variety of non-ferrous materials may be used.

than 240 volts, the HT winding connections should be reversed. Double check.

When identified, the winding connections should be made permanent, with adequate insulation over the connections.

With the connections established, the transformer core should be modified. Transformers are normally assembled with the "I" and "E" sections interleaved, as distinct from the separate "E" and "I" sections for a choke, with a strip of gap material between them.

This means that the transformer core must be completely removed, the "I" sections discarded, and the "E" sections reassembled all facing the one way. Removing the original core may not be easy. Varnished units will offer some resistance, but when one or two laminations

have been removed, the remaining ones can be peeled off with the aid of a thin knife blade. Wax impregnated units are easier to work on.

Place two mounting feet in position and clamp tightly with two through-bolts. Give the outer extremes of the laminations a squirt of lacquer to anchor them and minimise buzz.

Assuming that the above requirements have been satisfied, it should be possible to connect the two windings in parallel and to the 240V supply without risk of serious overheating during the brief period they will be on. If it should transpire that the best available units have insufficient turns, and do tend to overheat, they may be connected in series. They should be identical units for this arrangement.

We housed the complete eraser in a simple box made from plywood and aluminium. The base and two ends of the box are of plywood, and the front, rear, and top is folded from one piece of aluminium.

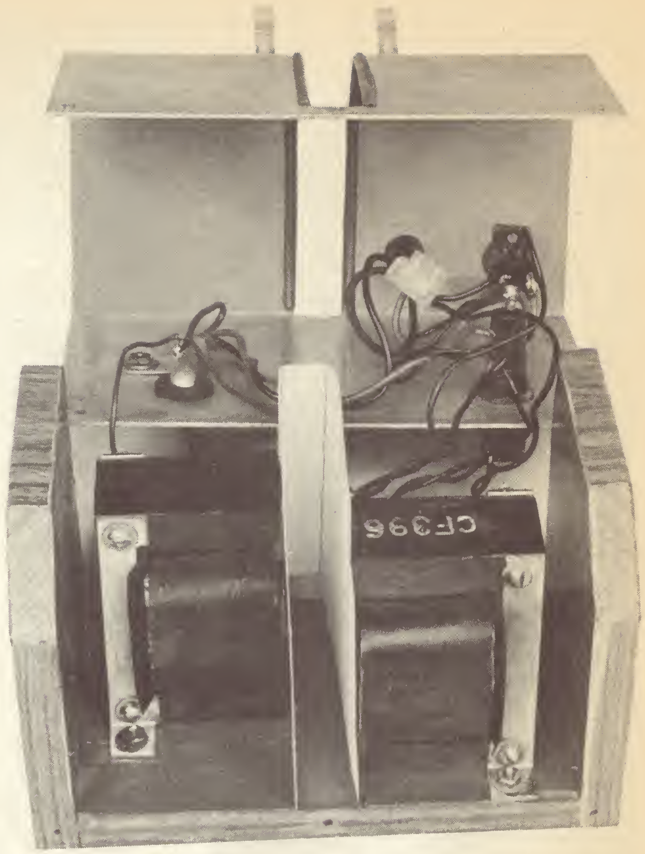
The wooden portion is made from a 3 5/8in (93mm) wide strip of plywood (or Pineboard). The base is 5½in (140mm) long and the two ends are 4in (102mm) high. One corner of each end is cut off, 1in in each direction to form an angle of 45°.

Fasten the end pieces to the base (on the end grain) with PVA wood glue and a few thin nails. When the glue has set, sand the whole assembly. Finish may be to your own taste. We applied a coat of full gloss paint and adhesive backed wood-grained plastic sheet, such as "Con-Tact".

The aluminium cover has a central slot through which the tape spool is inserted. On each side of the slot is a lug shaped as shown in the accompanying drawing. The two slots are designed to support a simple axle, such as a pencil, which, in turn, supports the reel. One pair of slots suits a 5in (127mm) reel and the other a 7in reel. The lugs may be made from any non-magnetic material. We used a piece of ¼in (6.5mm) acrylic, but wood, aluminium, brass etc, could be used by slightly modifying the design.

The cover is best marked out, drilled, and slotted in the flat. Then bend to shape and rub the outer surface with a fine (500) grit "wet and dry" paper, using a rubbing block and plenty of water. Finally, spray with a clear enamel.

Mount the first coil as far forward as possible without it fouling the cover when in place. Place it so that the open end of the laminations are not less than 5/16in (8mm) to the RHS of a centerline drawn across the depth of the base. Use countersunk machine screws (⅛in Whit or 4BA) and nuts, inserted from the underside.



The internal layout of the bulk eraser. Note particularly how the two coils are offset from each other. This provides adequate coverage for the larger reels. The folded cardboard between the coils is to protect the open ends of the windings. Since the unit will be connected to the mains, make sure all wiring is adequately insulated. Note the clamp on the mains lead.

To the LHS of the centerline, and at the same distance from it as the first coil, mount the second coil with its front edge level with the rear edge of the first coil. Cover the underside of the base with ⅛in felt cemented with a suitable contact adhesive.

To protect the open ends of the windings, cut a piece of thin cardboard 3½in x 7½in (89mm x 190mm) and form it into a "U" shape which will fit between the two core assemblies. Leave room in the rear section for interconnecting cables. Fasten with contact adhesive.

Before connecting the windings, ascertain arbitrary ends, ie, "start" and "finish," of each one. Code lead-outs from each winding suitably — either by knots or colors. The two methods of connection are shown in the accompanying diagram.

Fit the neon indicator, fuse holder, press button switch and mains lead (by a clip) to the aluminium cover. Connect to the appropriate leads as shown in the diagram.

With care, lower the aluminium cover over the assembly, making sure all leads are tucked in the space available to prevent them being pinched as the cover is screwed down.

To use the eraser, first take two precautions. Remove all valuable tape recordings to a distance of at least 3ft (1 metre) from the eraser, otherwise there may be a risk of partial erasure. Secondly, remove your watch. Even if anti-magnetic, it may not take kindly to having the hairspring rattled at 50Hz!

Place the tape spool in position with a pencil as an axle. Five inch spools use the inner slot and 7 inch spools the outer one.

Press the power button and rotate the spool at least twice very slowly without releasing the button. Application of power will be accompanied by a heavy hum.

If you release the button momentarily, count your rotation of the spool from the time and position you released the button. If power is disconnected with the spool in position, a "thump" will be recorded for every revolution of the tape.

After rotation, and still with power applied, slowly withdraw the spool a full arm's length from the eraser, and then release the button.

If the spool is rotated or withdrawn from the eraser too quickly, a burble will be recorded for every revolution of the spool.

Use the eraser only for sufficient time to erase a tape, as excessive "on" time may cause the coils to overheat, with the risk of a possible burn-out.

WOW! A NEW DUAL TRACE OSCILLOSCOPE FROM BWD

10MHz-10mv ALL SOLID STATE

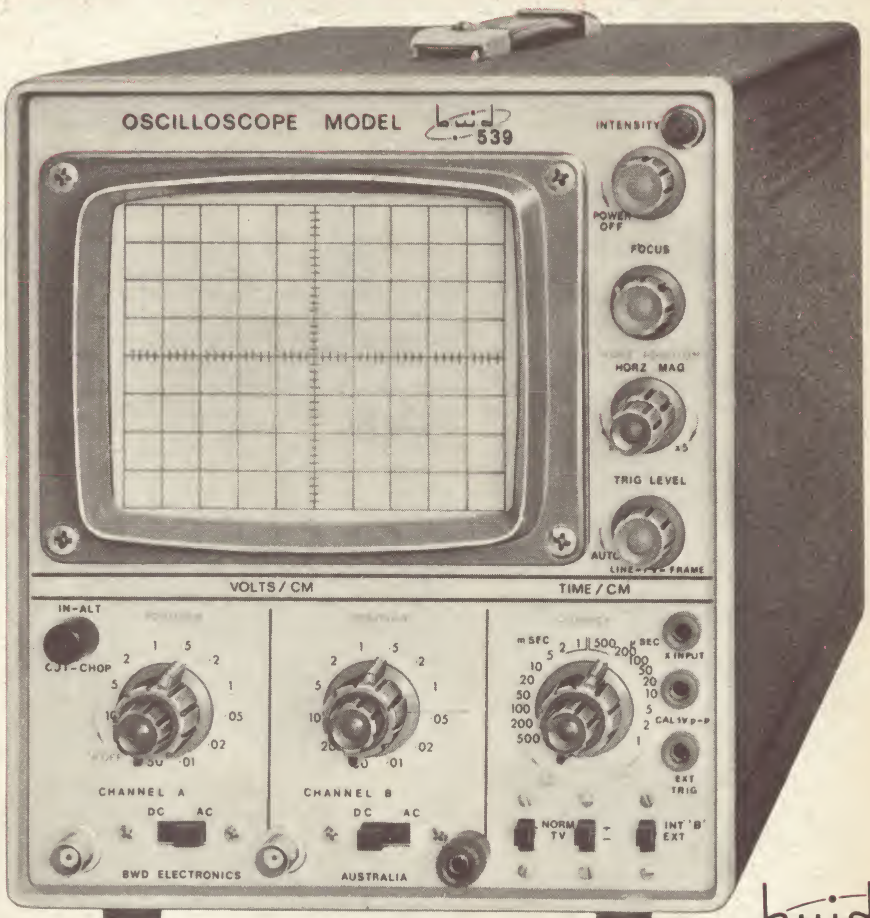
UNMATCHED VALUE & QUALITY

$365

Plus tax if applicable.

F.I.S. AUSTRALIA.

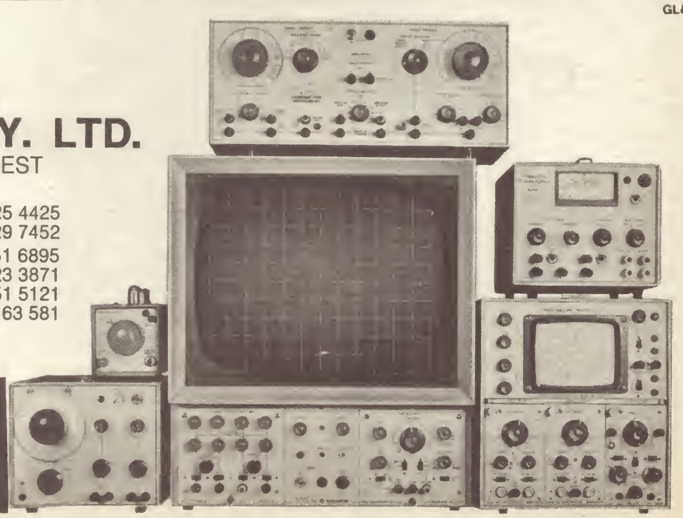
bwd 539 combines a sparkling performance with the renowned stability of a bwd oscilloscope. An 8 x 10 cm display with 3kV EHT, 10MHz triggering and an active T.V. Frame or Line lock. 5% calibration including 10% line change and a 2% calibration signal.



BRIEF SPECIFICATION
VERTICAL AMPLIFIERS; (both Channels). DC to 10MHz — 3db, 10mV to 50V/cm in 12 steps.
TIME BASE.
200nSec/cm to 2.5 Sec/cm range. 18 steps, 5-1 vernier and calibrated × 5 magnification. 2Hz to >10MHz auto trigger.
HORIZONTAL AMPLIFIER.
DC to >750kHz 0.6 to 6V/cm.
Write and call today for full specifications of this model and our wide range of highly competitive instrumentation.

MODEL 539

GL&C/993 BW



B.W.D. ELECTRONICS PTY. LTD.

DESIGNERS & MANUFACTURERS OF THE FINEST ELECTRONIC INSTRUMENTATION

329-333 Burke Road, Gardiner, Victoria 3146	Phone 25 4425
127 Blues Point Rd., Nth Sydney, N.S.W. 2060	Phone 929 7452
SOUTH AUSTRALIA: A. J. Ferguson Pty. Ltd.	Phone 51 6895
WEST AUSTRALIA: Cairns Instrument Services	Phone 23 3871
QUEENSLAND: Warburton Franki (Bris.) Pty. Ltd.	Phone 51 5121
NEW ZEALAND: P. H. Rothschild, Lower Hutt	Phone 63 581

BWD EXPORT ACTION
TO OVER 25 COUNTRIES

Sync & Pattern Generator for TV

Construction details for the new instrument, whose operation was described last month. Build it for CCTV or to prepare for colour TV!

Second of two articles by JAMIESON ROWE

The generator described in these articles is a flexible instrument which produces two different types of television signals. It produces a variety of test pattern signals, which among other things can be used for such purposes as convergence testing and adjustment of colour TV receivers, and linearity adjustment of monochrome receivers.

In addition it also produces a complete set of horizontal sync and blanking pulses, and is thus suitable for such purposes as interlocking closed-circuit television (CCTV) cameras, or serving as the master sync and blanking generator for an amateur television (ATV) station.

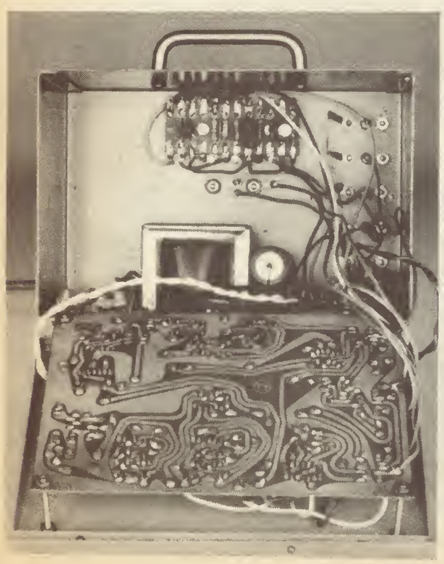
All of the signals generated by the unit conform substantially to the Australian TV standards, ie, they have a 625-line 50-field raster with a locked 2:1 interlace, and shaped sync and blanking pulses which are completely adequate for CCTV and ATV use. The test patterns can be displayed by any normal receiver or monitor designed for Australian broadcast television signals.

In the first article, published last month, I discussed the performance of the unit, and described the basic operation of each of its functional circuit sections. This article will complete the story by describing how to construct the generator.

The circuit of the complete generator is shown opposite. This may seem a little bewildering, but if you followed the breakdown of its operation given last month, it should not be hard to identify the various sections and trace the flow of signals. Refer back to the diagrams given in the first article if your memory needs a little refreshing.

As may be seen the 3.125MHz master crystal oscillator is a straightforward circuit using a Motorola MC799P dual buffer IC. I have used this oscillator configuration on previous occasions, such as the Crystal Frequency Calibrator of September 1969 and the 70MHz Digital Frequency Meter of May-June 1970. It gives reliable and stable operation with a minimum of components, even though in this case the frequency of operation is near the rated maximum frequency for the RTL devices.

A small ceramic trimmer is provided in the oscillator circuit to permit fine adjustment of frequency. This allows the line and field scanning frequencies produced by the SPG to be set to their correct values by comparison with a suitable reference such as the signals radiated by an ABCTV station during a national live program. Naturally the stability of the SPG signals will not be as good as such a reference, but with a stability of about 1 part in 100,000 provided by the crystal, it is sufficient to justify the vernier adjustment.



These shots show the inside of the case and the rear of the new sync and pattern generator. The row of sockets on the rear would only be required if the unit is to be used as a sync generator; they could be omitted if it is only to be used as a pattern generator for servicing work.

All of the stages in the main frequency divider chain of the unit use Motorola MC790P dual J-K flip-flop ICs. Because minimum-device logic configurations are used, a total of only ten of these devices are required. A single Fairchild FuL923 J-K flip-flop is used for the x2 horizontal frequency divider.

Most of the gating required for the synthesis of horizontal and vertical blanking and sync pulses is performed using Motorola MC724P quad 2-input gates, of which four are used. For the final gating and buffers used to produce the various logic outputs, Motorola MC788P dual 3-input buffers are used, three in all.

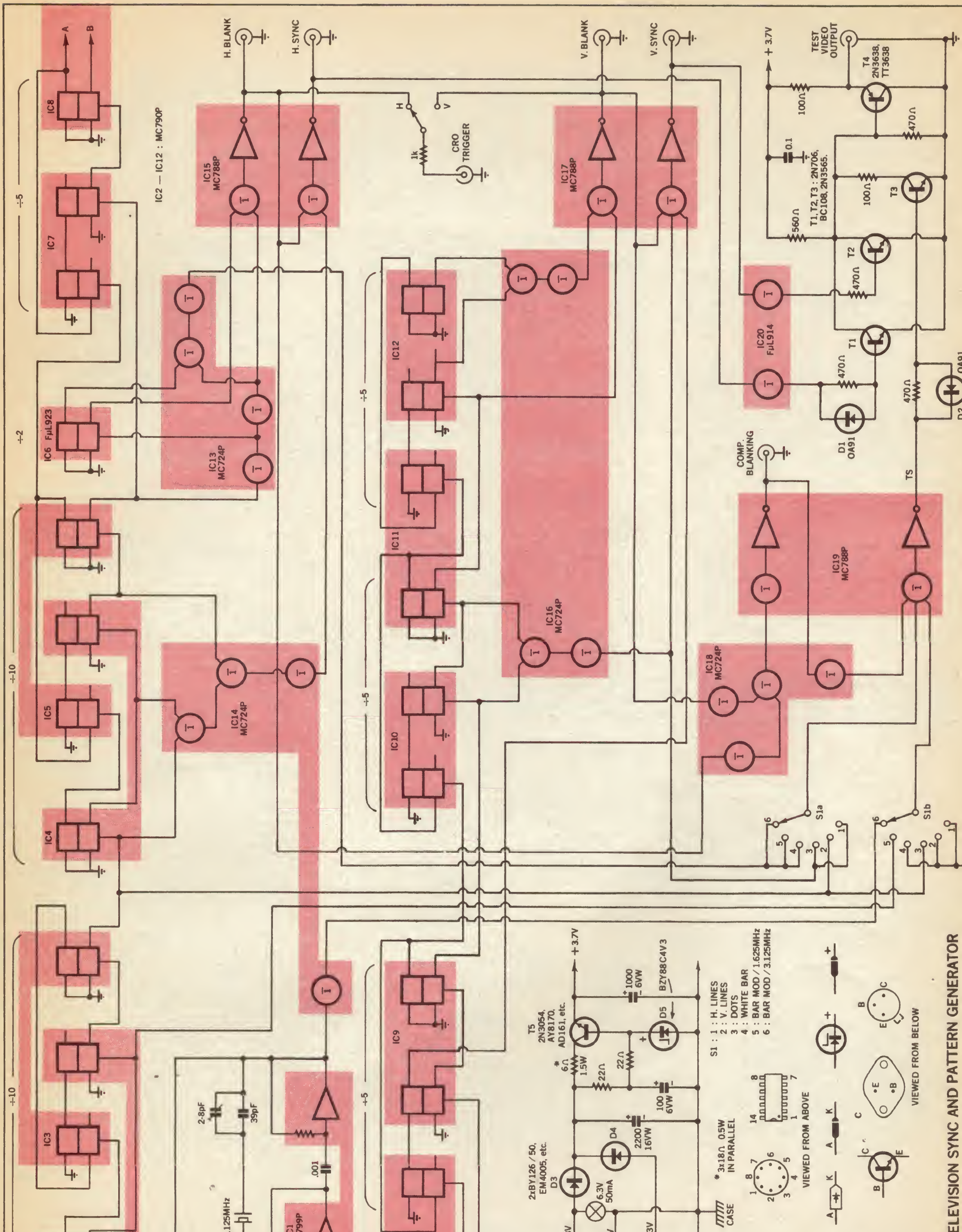
At this stage you may well be asking yourself why I have used simple RTL devices for the basic logic circuitry of the generator, when nowadays the higher performance TTL devices are readily available at approximately the same cost. Some readers may even be inclined to dismiss the design as "dated" because it uses the now less fashionable RTL devices.

My reason for using the RTL devices is that they are quite capable of doing the job required here, while at the same time they are not nearly as critical as the higher-performance TTL devices in terms of layout, bypassing, and so on. Where the higher performance is not really required I believe it would be unwise to use TTL devices and thus needlessly increase the likelihood of readers getting into strife.

All of the components and wiring described this far are mounted on a printed wiring board, which measures 6-7/8in x 4¾in (175 x 121mm). This board therefore carries most of the wiring of the SPG, and simplifies construction considerably. The diagram of Fig. 7 shows the way in which the board is wired.

The oscillator trimmer capacitor for which the board pattern has been designed is the same 2-8pF NPO ceramic unit used in previous projects, the type DV11PR8A distributed by the Imported Components Division of Plessey Ducon Pty Ltd.

The only sections of the circuit not mounted on the wiring board are the video test signal synthesiser section and the power supply.



TELEVISION SYNC AND PATTERN GENERATOR

The video test signal section was described in some detail in the first article. It uses a Fairchild FuL914 dual 2-input gate IC to invert the horizontal and vertical sync pulses, and then discrete circuitry to synthesise the video waveform. The discrete circuit uses three general-purpose NPN silicon transistors such as the 2N3565 or BC108, together with a silicon PNP transistor such as the 2N3836A or TT608.

The components and wiring of the video section are mounted on a 12-lug section of miniature resistor panel, whose wiring is shown in Fig 8.

The power supply of the generator is a straightforward circuit using a transformer and full-wave rectifier followed by a series regulator using a zener diode reference. The supply is designed to deliver a nominal 3.7 volts at approximately 690 milliamps, with low ripple.

Silicon rectifier diodes such as the BY126/50, EM401 or similar may be used for the power supply rectifier, while the series regulator may be any suitable NPN medium power TO-66 device such as the Fairchild AY8170 or AY8171, the 2N3054, the RCA type 40250, or even the germanium AD161. The zener diode should be any type with a nominal voltage around 4.3V and a rating of around 400mW. I used the Philips BZY88/C4V3, but other types may be used if on hand.

If the diode used has a breakdown voltage much lower than 4.3 volts, it may be necessary to wire one or more forward-biased silicon diodes (the rating is not important) in series with it to bring the supply output voltage up to between 3.6 and 3.8 volts. Each diode added in this way will effectively increase the zener voltage by about 0.6V, and the output voltage by a slightly smaller amount.

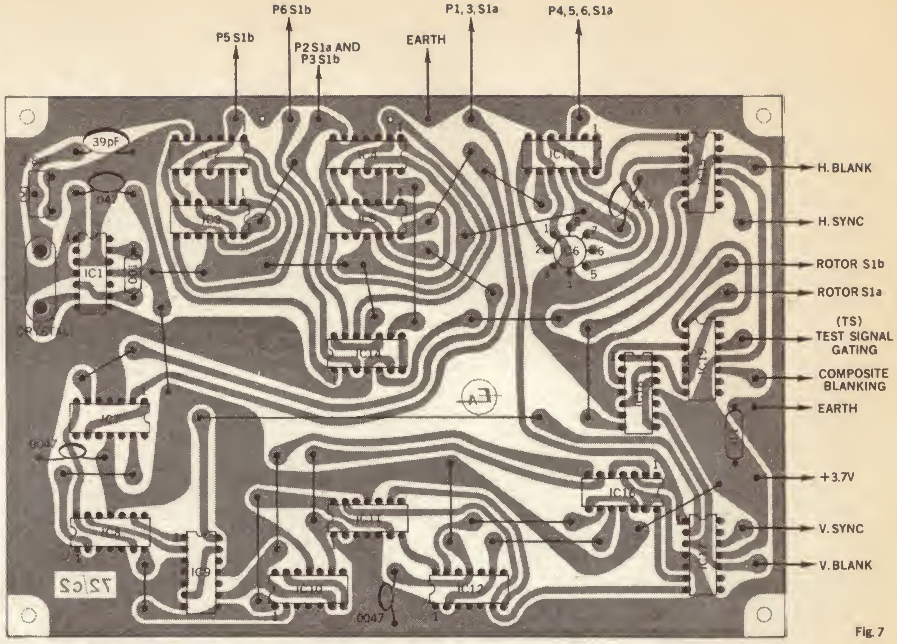


Fig. 7

Actually if a 4.3V or lower zener is completely unobtainable, it is quite in order to use a string of low cost forward-biased silicon diodes in series to build up the required voltage. Seven or eight diodes would be required.

The components and wiring of the power supply are supported on another section of miniature resistor panel, in this case a section 8 lugs long. The wiring of this panel is shown in Fig. 9.

From the photographs it may be seen that the prototype generator is housed in a standard small instrument case, measuring 7½in x 5in x 4in (190 x 130 x 105mm). This case was used mainly because I had it on hand. If you intend building the unit for use with CCTV cameras or for ATV work, this physical format should be quite appropriate.

On the other hand if you mainly intend using it for convergence work with colour TV sets and monitors, and for linearity work with monochrome sets, then a simpler format and a more compact case could be used. The sync and blanking output connectors could be left off if not desired, and the wiring to them from the board ignored. Similarly the CRO sync signal switch and output connector could also be left off if not required.

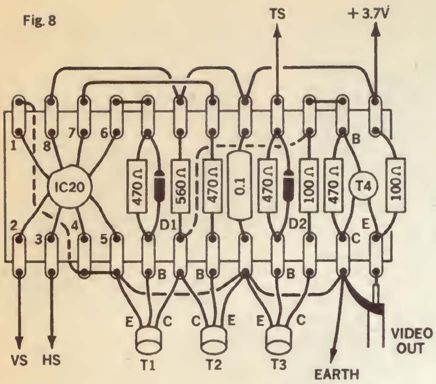
On the prototype generator the front panel provides the mains switch and pilot, the test pattern selector switch, the CRO sync switch and the output connectors for the video test pattern and CRO sync signals. The vertical and horizontal sync and blanking outputs and the composite blanking output connectors are mounted in a vertical row on the rear of the case, as shown in the photograph. The printed board is attached to the rear of the front panel by means of four 1½in long ⅛in Whitworth screws, using three nuts on each screw to space the board from the panel by 1¼in.

The power transformer and power supply wiring strip are mounted on the bottom of the case, with the series regulator transistor mounted externally on the centre of the case rear. The wiring strip for the video test signal circuitry is mounted on the case rear above the regulator transistor.

As most of the involved wiring of the generator is performed by the printed wiring board, construction of the unit is quite straightforward. Using the diagrams and photographs it should not present any problems, even for the constructor as yet unfamiliar with ICs.

Before closing there are a few comments

Fig. 8



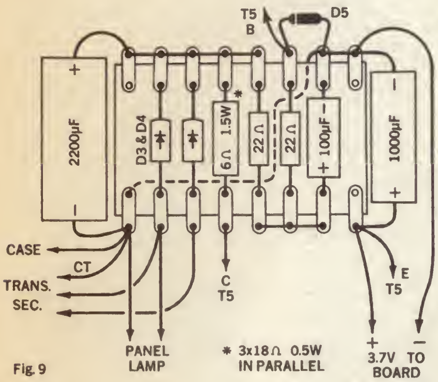


Fig. 9

which I should perhaps make. The first concerns the horizontal lines test pattern; as you may have noticed from the photographs given last month, this pattern does not have the lines equally spaced.

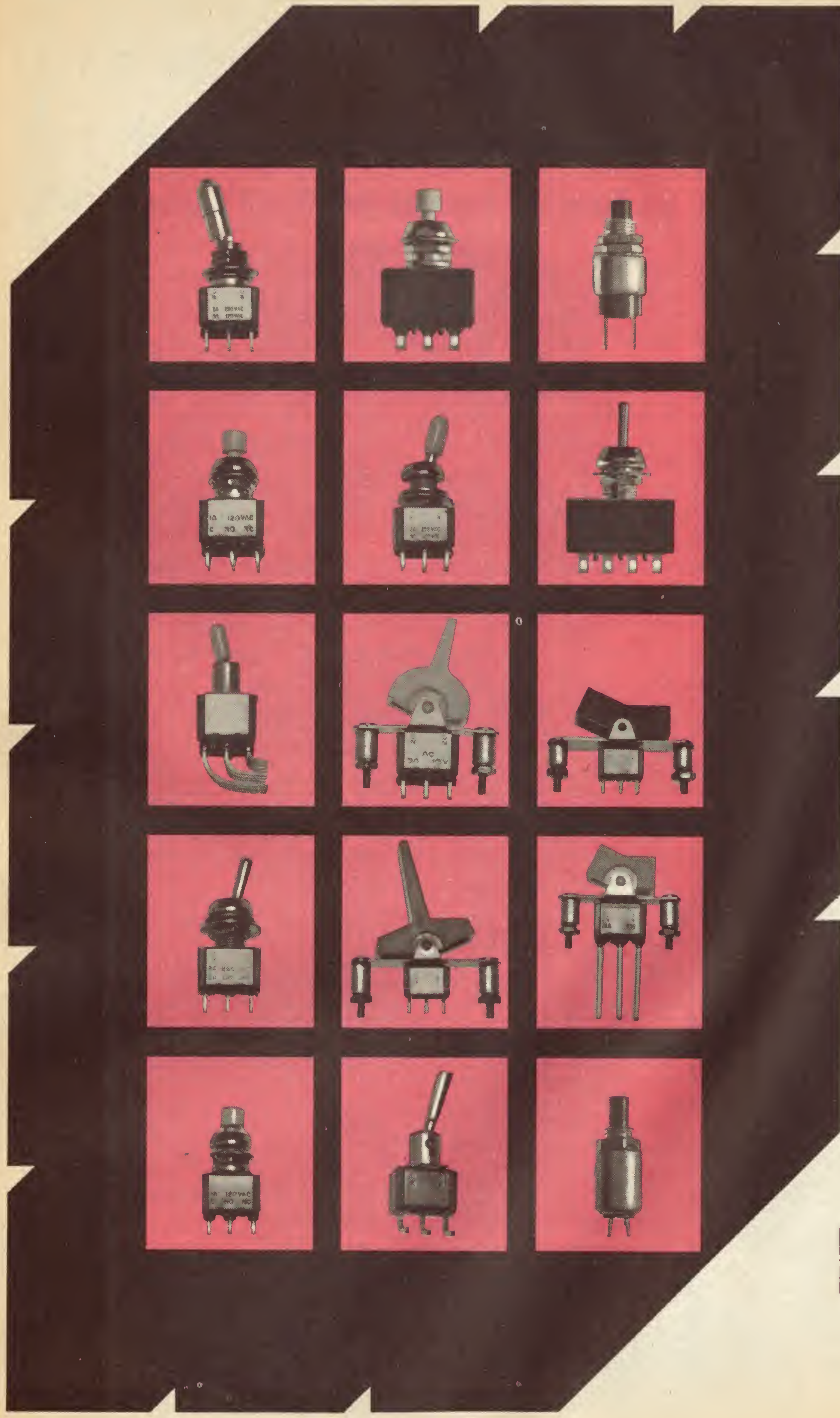
It would of course have been very desirable to have the lines of the pattern equally spaced, as this would simplify considerably the use of the pattern in checking and adjusting vertical scan linearity. However try as I did when developing the generator, I couldn't find any easy way of generating a pattern with a reasonable number of equally spaced horizontal lines. The pulses and frequencies are just not readily available from the divider chain and logic circuits, hence the pattern shown.

Actually despite first appearances, the pattern produced is still very useful for vertical linearity work. After a bit of practice it is really quite easy to mentally and visually allow for the alternate 1 line / 2 lines spacing, and adjust the vertical scan linearity to make the pattern "uniformly alternating".

My next comment concerns the pattern in which the vertical bar is modulated with the 1.562MHz test frequency. Because the 1.562MHz signal used for this pattern is derived directly from a flip-flop in the divider chain, its peak-to-peak amplitude is less than the 3V available from the output of a logic gate. Hence the bar modulation for this pattern tends to be a little lower than with the other patterns.

This need not cause problems, as the contrast control of the set or monitor can usually be turned up to compensate. For this reason I have not added additional components or wiring in order to overcome the effect. However if you find it irritating or it prevents serious evaluation of high-frequency response, I can suggest two ways in which it might be remedied.

One way would be to arrange that the gate in IC14 used to buffer and shape the



all shapes and sizes of sub miniature switches

Toggle, rocker, pushbutton, paddle, lever lock . . . every practical alternative lever action combined with maximum performance, minimum weight and size and available in one, two, three and four pole models. Subminiature switches manufactured by C & K Components Inc. U.S.A. are readily available in just about every shape, size and configuration imaginable and they are readily adaptable to a multitude of uses where space is at a premium. All switches feature rugged construction and simple mounting . . . long-term, trouble-free operation is ensured. Toggle switch contacts are rated 2 amps @ 240v. AC and 5 amps @ 28v. DC resistive load. The full C & K range is now available from the Professional Components Department, Villawood, NSW or Plessey Ducon Interstate agencies. Catalogue containing full specifications, options, information on hardware, panel layouts, mounting, etc. is available on request.

PLESSEY Ducon

Plessey Ducon Pty. Limited
PO Box 2 Villawood
NSW 2163 Tel. 72 0133
Perth 21 4821
Henderson (N.Z.) 64 189

AD45

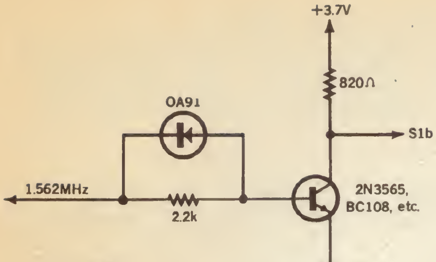


Fig. 10

3.125MHz signal is also used to perform the same functions for the 1.562MHz signal. This would involve using a three-pole 6-position switch for S1, with the third pole used to select the signal fed to the gate input. The copper conductor on the board linking the gate input to the 3.125MHz crystal oscillator would have to be carefully cut with a razor blade, and wires taken to the switch from both sides of the cut along with the wire from the 1.562MHz output. The output of the gate would then be connected to position 5 of S1b, as well as position 6.

The other way, and probably the simpler, would be to add a simple one-transistor buffer and shaper in the line between the 1.562MHz board output and position 5 of S1b. This would involve nothing more than a 2N3565, BC108 or similar NPN silicon transistor, with an 820 ohm resistor to +3.7V in the collector circuit, and a 2.2K resistor in series with the base, possibly with an OA91 diode in parallel to speed up turnoff. Fig. 10 shows the idea.

My final comment concerns the possibility of providing a cross-hatch pattern test signal, if this is required. Although a cross-hatch pattern offers little that is not provided by the vertical lines, horizontal lines and dot patterns, there may be some constructors who would like to have such a pattern available. Needless to say, it is possible to produce such a pattern in the present generator, because we have the necessary vertical and horizontal line signals available, and a cross hatch signal is formed from these. But whereas the dot pattern is formed by a logic AND operation combining the two, the cross-hatch is formed by an OR operation.

The simplest way of producing a cross-hatch logic signal with this generator is shown in Fig. 11. A Fairchild FuL914 dual gate IC is all that is required, with one gate wired as an inverter for the 312.5kHz vertical lines signal and the other used to combine this signal with an inverted horizontal lines signal taken from pin 2 or pin 5 of IC16 on the main wiring board.

The output from the circuit would be fed to a suitable position on switch S1a or S1b —

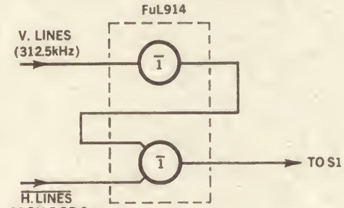


Fig. 11

replacing one of the patterns at present provided. Which pattern is omitted in preference to the cross-hatch is a decision I will leave up to you. It would also be possible to keep all the present patterns as well as the cross-hatch, by using a 7-position switch, but bear in mind that a two-wafer switch may involve space problems. Whichever section of S1 the cross-hatch signal is taken to, the corresponding lug on the other section should be earthed.

That I think ends the story. It would perhaps have been nice to have been able to describe the use of the generator for convergence adjustment of colour TV sets, but space will not permit. We will deal with this subject later, in the detail it deserves.

Parts needed for Sync Generator

1 Instrument case, 7½in x 5in x 4in.
1 Printed wiring board, 72/c2.
1 Power transformer, 240V to 12.6V CT at 1A.
1 Rotary switch, 2-pole 6-position.
1 Quartz crystal, 3.125MHz.
2 Miniature toggle switches, SPST.
7 Co-axial connectors.
1 Miniature pilot bezel, 6V 50mA.

SEMICONDUCTORS
10 MC790P dual J-K flip-flop
4 MC724P quad 2-input gate
3 MC788P dual 3-input buffer
1 MC799P dual inverter-buffer
1 FuL923 J-K flip-flop
1 FuL914 dual 2-input gate
3 2N706, 2N3565, BC108, etc
1 2N3638, TT3638, TT608, etc
1 2N3054, AY8170, AD161 or similar
2 OA91 or similar
2 BY126/50, EM4005 or similar.
1 BZY88/C4V3 or similar

CAPACITORS
1 39pF NPO ceramic
1 .001uF 100V polyester
2 .0047uF 100V polyester
2 .047uF 100V polyester
2 0.1uF 100V polyester
1 100uF 6VW electrolytic
1 1000uF 6VW electrolytic
1 2200uF 10VW electrolytic
1 2-8pF variable ceramic, NPO

RESISTORS
Half-watt, 5% tolerance: 3 x 18 ohms, 2 x 22 ohms, 2 x 100 ohms, 4 x 470 ohms, 1 x 560 ohms.

MISCELLANEOUS
12-lug and 8-lug sections of miniature resistor panel; socket for quartz crystal; 4-segment section of "B-B" mains connector strip; control knob for selector switch; mains cord and plug, also C-clamp for cord; handle for case, also rubber feet; 4 x 1½in screws for mounting printed wiring board; nuts, screws, solder lugs, connecting wire, etc.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.

PA amplifier/mixer

Do you have the need for a compact but flexible public-address amplifier? If you have a few hours to spare you can build this new 20 watt solid-state unit — it has two microphone channels and two ceramic cartridge channels, with full mixing facilities.

an audio project by LEO SIMPSON

Power: 21 watts continuous into an 8-ohm load; 13 watts continuous into a 16 ohm load.
Distortion: Less than 0.3% at 21 watts into 8-ohms at 1kHz; at lower power within range 100Hz to 10kHz, typically less than 0.2% for microphone and phono inputs.
Frequency response at 1 watt: ±1dB from 20Hz to 20kHz for microphone and phono inputs.
Tone control: 0 — 16dB cut at 10kHz.
Inputs: Unbalanced microphone inputs with sensitivity better than 5mV for 21 watts at 100k input impedance; Phono inputs 250mV at 500k.
Signal-to-noise ratio: better than 60dB for phono inputs; better than 48dB for microphone inputs.
Control interaction: less than 1dB over audible range.

For a unit that is so compact, measuring 10 x 10 x 4 inches (254 x 254 x 102mm) including knobs and feet, this new Playmaster public address amplifier offers great flexibility, and it has high quality specifications to match. Although not high-powered, it will deliver 21 watts continuous power into an 8-ohm load or 13 watts continuous into a 16 ohm load — adequate for most ordinary PA applications.

Harmonic distortion at 1kHz for 21 watts output is less than 0.3%, while at lower powers it is typically less than 0.1%. Power bandwidth using 3dB points and a rated distortion of 0.5% is from 20Hz to 20kHz.

There are two microphone inputs, with individual level controls designated Mic 1 and Mic 2. With an input impedance of 100k and a sensitivity of better than 5mV for 21 watts into 8 ohms, the inputs are suitable for medium to high impedance dynamic microphones.

There are two phono inputs, again with their own individual level controls. These have a sensitivity of 250mV and an input impedance of 500k, making them suitable for medium to high output ceramic or crystal cartridges. The input impedance of 500k is not optimum for piezoelectric cartridges but the slight reduction in bass response is not a problem for public address work. In fact the reduction becomes negligible if a stereo cartridge is used, with both channels connected in parallel — this increases the source capacitance and thus reduces the required input impedance for good bass response.

But note that low output ceramic cartridges such as the Decca Deram or Connoisseur SCU-1 are not suitable for use with this amplifier.

A simple "top-cut" tone control is fitted and this acts on all input signals. Maximum available treble attenuation is -16dB at 10kHz. This is more than adequate to take care of scratchy records and peaky microphones.

Interaction between the various input level controls is negligible at less than 1dB over the audible frequency range. Frequency response for both microphone and phono inputs is ±1dB from 20Hz to 20kHz.

Signal -to-noise ratios range from -60dB for phono inputs to -48dB for microphone inputs. These figures are with respect to 21 watts into 8 ohms, are unweighted (ie, wideband noise) and are taken with inputs open-circuit. The figures improve considerably when the inputs are loaded. With level controls set for normal use, the amplifier is very quiet.

Extensive precautions have been taken to ensure freedom from RF breakthrough from such sources as taxis, radar, broadcast and shortwave stations. The amplifier is also insensitive to mains-borne interference such as commutator hash from universal motors, clicks and pops from switching inductive loads.

Electronic short-circuit protection facilities have not been provided, as fuse protection has been found to be quite adequate. However the amplifier should not be used with loudspeaker loads lower than 8 ohms, to ensure completely reliable operation.

Under normal conditions and when used for public address, the amplifier will run cool or just slightly warm to the touch. If it becomes very hot at the rear of the chassis, it is either being overdriven (which should be painfully audible), or is not getting sufficient ventilation, or for some reason is unstable at radio frequencies. In all these cases, corrective action should be taken immediately to prevent damage occurring.

The heart of the unit is a new power IC device, the TA 20B. This is a 20 watt thick film hybrid IC distributed in Australia by STC. The internal circuit is shown in Fig 1. The amplifier circuit is based on the conventional "quasi-complementary" class-B configuation but has several interesting features.

A differential amplifier stage consisting of Tr1 and Tr2 establishes the amplifier DC

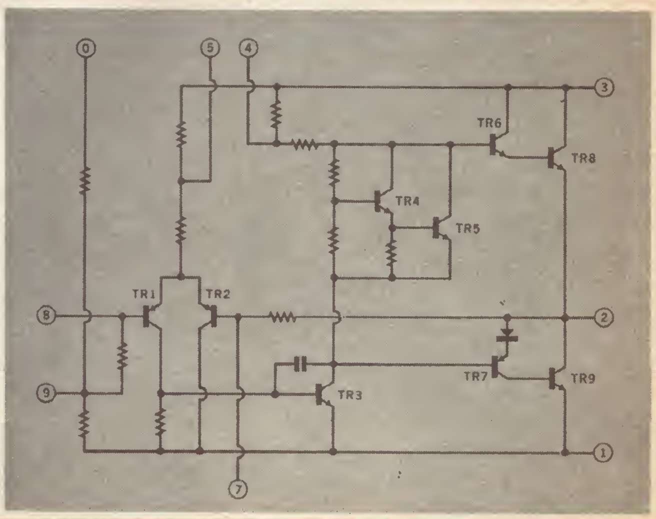


FIG. 1. COMPACT 20 WATTS. The new integrated circuit AF power amplifier is shown approximately actual size. An equivalent circuit of the thick film hybrid IC is shown at the right.

...features new power IC

"half-supply" voltage across the output coupling capacitor, making it relatively independent of supply voltage fluctuations. This assures symmetrical clipping when overload occurs. The main negative feedback loop, which applies both AC and DC feedback, is from pin 2 to the base of Tr2 via a resistor.

Tr3 provides further voltage amplification for the input signals and acts as a class-A driver stage for the output driver transistors Tr6 and Tr7. Phase-splitting for the output NPN transistors takes place in the driver transistors.

The diode in series with the emitter of Tr7 improves the symmetry of the quasi-complementary output stage and greatly reduces the harmonic distortion at low power levels.

The quiescent current for the output stage is set by the voltage drop across the Darlington transistor pair consisting of Tr4 and Tr5. There is no means of adjusting this current externally. Normally it should be in the region of 30mA and no more than 50mA.

Boot-strapping (ie, positive feedback) is intended to be applied via a 47uF 25VW capacitor from the output at pin 2 to the input of Tr6 at pin 4. This ensures that the full voltage swing is available at the output.

Typical voltage gain of the power amplifier is 30 times for all load impedances. This results in a basic sensitivity of better than 450mV for 21 watts into 8 ohms. Input impedance is 20k minimum.

For the basic power amplifier there are eleven external components, beside the 2200uF output capacitor, associated with the TA-20B amplifier. These are mounted on a printed board measuring 4 x 3¼ inches. Besides the 47uF bootstrap capacitor mentioned above, there are two supply decoupling capacitors, 47uF and 250uF and an RF supply bypass capacitor, 0.1uF. The last mentioned capacitor is mounted on the underside of the board, directly between pins 1 and 3 of the TA 20B.

In addition, there is the external part of the feedback network, consisting of 1k and 47uF 25VW capacitor in series. The 1k resistor sets the overall gain while the 47uF capacitor sets the low frequency roll-off point. The rest of the components on the board are the 0.33uF input coupling capacitor, a Zobel output damping network consisting of a 4.7 ohm resistor and .047uF capacitor in series, and also an RF choke L1 in parallel with a 10 ohm resistor.

These four last-mentioned components ensure that the amplifier is stable with highly reactive loads, both inductive and capacitive. Thus the amplifier is completely stable with any capacitance up to 1uF shunting the load.

Driving the power amplifier is a four-channel mixer. It has two microphone preamplifiers, two impedance-matching stages for the phono inputs, passive mixing and a voltage amplifer stage to make up the losses in the mixing circuitry.

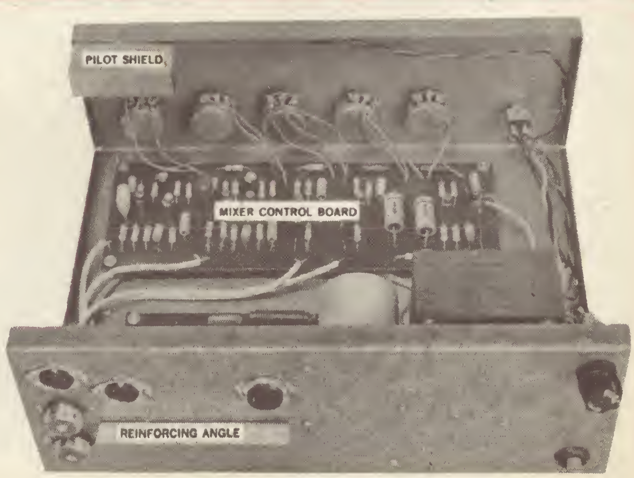
The microphone preamplifiers are direct-coupled NPN transistor pairs with several interesting features. Bias for the input transistor is derived from the junction of the 270 and 560 ohm resistors in the emitter circuit of the second transistor. This circuit assures DC stability of the output voltage at the collector of the second transistor. AC negative feedback is applied from the collector of the second transistor to the emitter of the first transistor via the 100k resistor shunted by a 47pF capacitor. The capacitor rolls off the response above the audible range to assure low RF sensitivity.

In addition to rolling off the response at high frequencies, there is an RF attenuation network in the input circuit. It consists of a series 10k resistor and shunting 100pF capacitor. This prevents strong RF signals entering the base of the first transistor, which due to its basic non-linearities can "detect" RF signals and thus make them audible. Voltage gain of each preamplifier is approximately 50 times.

The impedance matching stages for the phono inputs are identical, each being an emitter-follower using an NPN transistor. Voltage gain of these stages is 0.9.

Output signals from each of the preamplifiers and impedance matching stages are

Turn page for circuit diagram



PA amplifier, cont

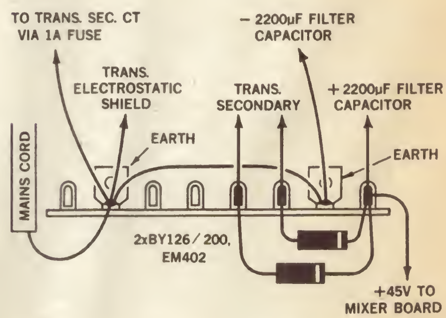
fed to a voltage-amplifier stage consisting of an NPN transistor. Since this stage has an input impedance of 10k, the voltage losses in the mixing network are 5:1. Overall voltage gain of the following stage is approximately 10 times, which therefore more than compensates for the loss.

Again, the response of this stage is rolled off above the audible limit to reduce RF sensitivity. This is accomplished by the 100pF capacitor connected from base to collector.

Current drain of each of the microphone preamplifiers is 4 milliamps, the emitter-followers 0.8 milliamps and the mixer voltage-amplifier 1.2 milliamps. All of the circuitry just mentioned is accommodated on a printed board 3 x 8 inches. With two of these printed boards a high performance stereo mixer can be easily assembled.

The power supply for the amplifier is simplicity itself. The power transformer has two 32 volt windings which are connected in series to give 64 volts centre-tapped. The power transformer is the same as for the 10-plus-10 stereo amplifier published in April 1969; suitable type numbers are the Ferguson PF 2876 or the A & R PT 6413. A full-wave rectifier consisting of two 200 PIV / 1 amp silicon diodes supplies the 2200uF filter / reservoir capacitor.

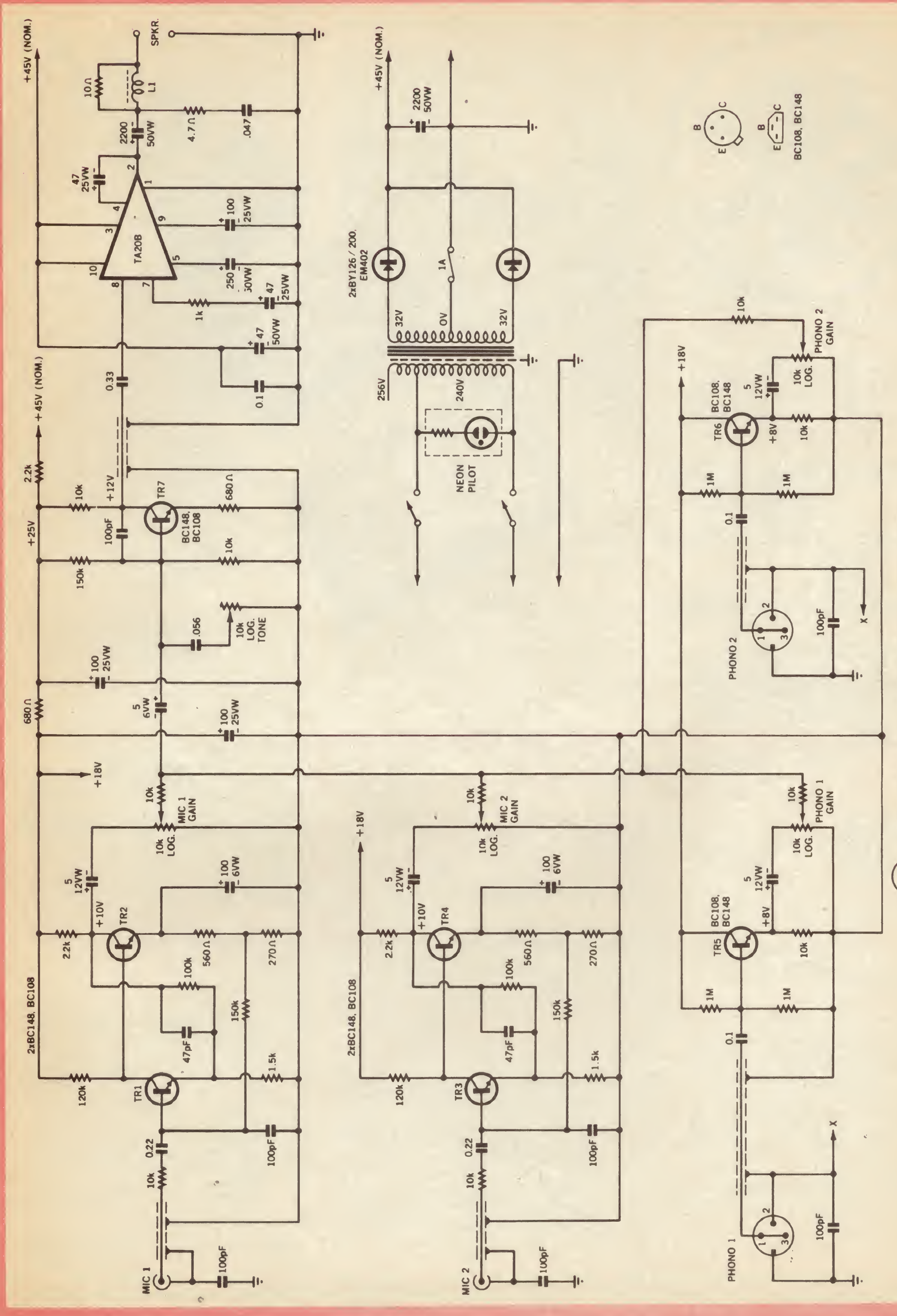
A 1-amp fuse connected in series with the centre-tap connection provides protection for the amplifier and power supply components against short circuit loads and over loading.



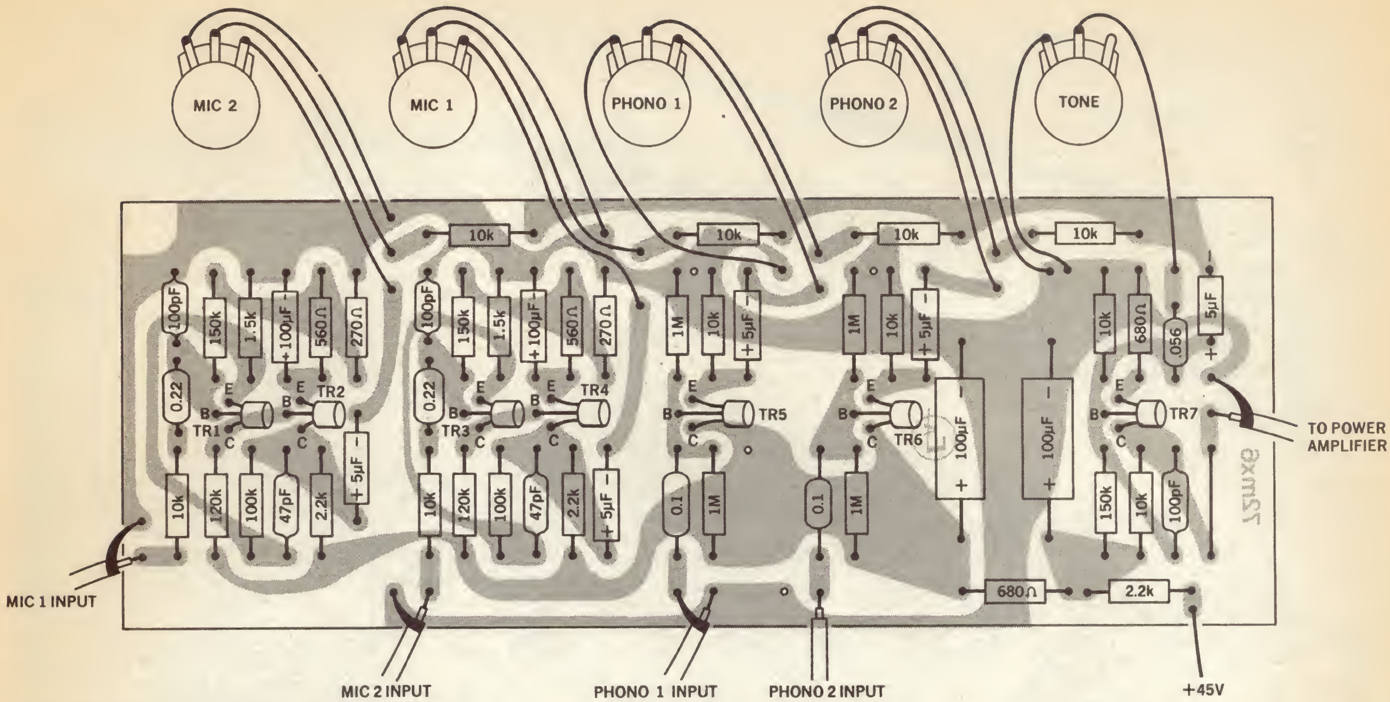
POWER SUPPLY DIODES are mounted on tagstrip as shown above. Right hand earth lug is the only chassis connection to power amplifier.

CONSTRUCTION: The amplifier is assembled in a chassis with overall dimensions of 10⅛ x 3¼ x 8⅜ inches (257 x 83 x 213mm). The chassis is, in fact, a slightly modified version of that used for the Playmaster 129 integrated circuit amplifier published in October 1970. It was supplied by courtesy of Heating Systems Pty Ltd, 19-21 The Boulevarde, Caringbah, 2229. We assume that chassis will be available for the PA amplifer shortly after this issue goes on sale.

First components to be mounted are the 2200uF / 50VW can-type electrolytic capacitors. The fuseholder, power transformer and input sockets can then be installed. Note that the "button-type" microphone sockets must be insulated from the chassis using the rubber washers provided. The "earthy" sides of the sockets are connected to an adjacent tagstrip on the



20W PUBLIC ADDRESS AMPLIFIER



Above is the printed wiring board for the mixer control section with connections to the front panel control potentiometers shown along the top. At lower left is the printed wiring board for the power amplifier showing connections to the IC. Boards are shown as viewed from the component side.

PA amplifier, cont.

chassis via 100pF capacitors. Similarly, the shield of each phono input cable is connected to the shield of the DIN sockets via a 100pF capacitor in each case. The 100pF capacitors prevent RF being radiated inside the chassis by the input cable shields.

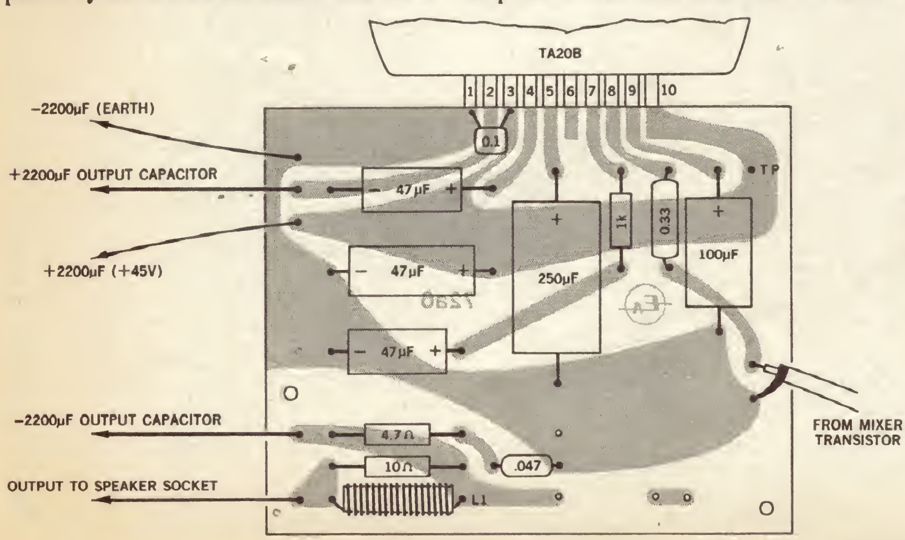
The power amplifer board can now be assembled. All the passive components, with the exception of the 0.1uF capacitor should be installed first. The RF choke L1 consists of 20 turns of 22 SWG enamelled copper wire on a 1in long section of ¼in diameter ferrite rod. Remember that if a ferrite rod has to be cut to length, it may be done by filing a nick around the circumference at the required point and snappping as if it were glass.

The integrated circuit pins are soldered direct to the edge of the printed board. The ten pins are bent up at right-angles at the point where they taper suddenly. The board assembly can then be installed. It is supported by two screws and nuts so that it has ¼in clearance from the chassis. The integrated circuit is secured to the rear of the chassis by two screws.

If the screws are over-tightened the chassis rear will become warped, and if this occurs it will not make good thermal contact with the metal backing of the integrated circuit. To avoid this, an L-shaped reinforcing piece should be secured to the rear of the chassis with the same screws that hold the IC in place. Silicone jelly should be lightly smeared over the back of the IC to improve thermal contact.

Assembly of the mixer control board is more straightforward. Note that the shield for one of the phono input cables is not connected to the board but is connected only to the shield of the other phono input cable at the sockets. This is to avoid earth loop problems. The output signal cable to the power amplifer is connected to two printed board pins to facilitate soldering. All the connections to the pots are made via unshielded wire.

Note that the complete circuit of the PA amplifer is connected to the chassis at one



JAPANESE REVALUATION BRINGS PRICE RISES – PUTS MORE VALUE THAN EVER INTO

Connoisseur

"the best of British"

BD2 NOW WITH SPEED CHANGE!

the world famous
Connoisseur BD2 integrated transcription unit lays a great foundation for top stereo sound. It incorporates the SAU2 high precision tone arm, inbuilt hydraulic cueing control placed conveniently at the front edge of the baseplate, and stop / start switch. It is powered by a 14 pole synchronous motor driving a precision-ground rubber belt, and can be supplied ready to install, or complete with base and acrylic cover.

Connoisseur BD1 turntable, built to the same "no compromise" specifications as the BD2, comes without tone arm and is fitted with a smaller mounting plate to permit installation of any type of arm. It is available ready to play, or in easily assembled kit form at lower cost.

Hear Connoisseur at the selected Interdyn specialist agents below, or write to us for authoritative reviews.

Interdyn specialist agents:

N.S.W.: Encel Electronics Pty. Ltd., 260 Elizabeth St., Sydney.
Q'ld.: Stereo Supplies, 100 Turbot St., Brisbane, 4000.
S.A.: Challenge Hi-Fi Stereo, 6 Gays Arcade, Adelaide.
TAS.: Audio Services, 72 Wilson St., Burnie. 7320.
VIC.: Encel Electronics Pty. Ltd., 431 Bridge Rd., Richmond. 3121.
W.A.: Albert TV & HI-FI, 282 Hay Street, Perth, 6000.

Sole Australian Distributors:

INTERDYN

International Dynamics (Agencies) Pty. Ltd.
P.O. Box 205, Cheltenham, Vic. 3192.

lease send information on Connoisseur ....

NAME ....

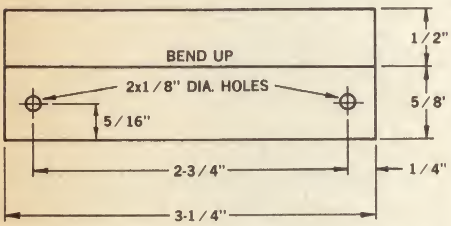
ADDRESS ....

.... EA8614

PA amplifier, cont.

point only: this is at the 8-lug tagstrip which accommodates the rectifier diodes and some of the the transformer terminations. It is extremely important that details of shield wiring around the input sockets as indicated on the wiring diagram are followed exactly to the letter. If this is not done, the amplifier could be unstable, prone to RF pickup or just plain noisy due to earth loops.

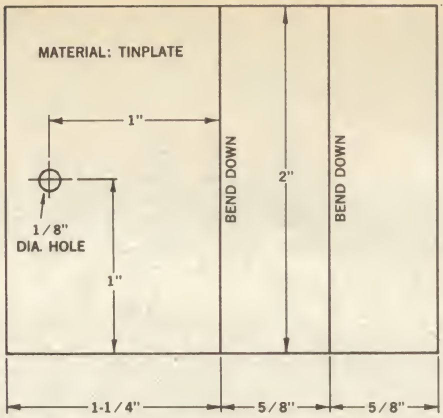
The pilot light is a neon assembly containing a limiting resistor, and is connected directly across the mains. The leads to it should be twisted and arranged as shown in the photograph and wiring diagram. In addition, a tinplate shield is arranged over the pilot assembly to stop hum radiation.



Dimensions for the L-shaped reinforcing piece which assures good thermal contact of the IC to the rear of the chassis.

Both sides of the mains are switched, using a DPST switch. The transformer primary leads are terminated directly to the switch, as are the leads for the neon pilot. The switch used in the prototype was actually a DPDT type with one half unused.

The mains cord should be passed through a grommetted hole in the rear of the chassis



Dimensions for the hum-prevention shield to be mounted over the rear of the pilot light assembly.

and anchored by a clamp. This can be secured by one of the screws which hold the 8-lug tagstrip.

Having assembled the amplifier, the unit can be switched on, with the supply lead to the amplifier disconnected. If the DC voltage across the 2200uF capacitor is more than 50 volts, the 256 volt tap on the transformer should be used instead of the 240V connection. This will reduce the supply voltage slightly.

When this is done the supply may be connected to the amplifier. Current drain with no signal should be between 20 and 50 milliamps. If it is substantially more than this, the unit is probably oscillating supersonically. Switch off and check that you wiring is exactly the same as in the wiring diagram.

The voltage across the 2200uF output

(Continued on Page 113)

PA amplfier — parts list

1 chassis, 10⅛ x 8⅝ x 3¼ inches, with cover.
1 reinforcing angle piece (see text)
1 neon pilot shield (see text)
1 power transformer, 64V centre tapped, at 2A AC.
1 printed board, 72a6
1 printed board, 72mx6
2 3-pin DIN sockets
1 2-pin loudspeaker socket
2 button type microphone sockets (with insulating washers)
1 fuseholder and 1 amp fuse
5 knobs
1 front panel
1 neon pilot light assembly
1 miniature 240V DPST switch
1 8-lug tagstrip
1 mains cord clamp
4 rubber feet

SEMICONDUCTORS
2 EM402 or BY126/200 silicon diodes
7 BC108, BC148, or 2N3565 silicon NPN transistors
1 TA20B power amplifier IC (STC)

CAPACITORS
2 x 2200uF/50VW electrolytic
1 x 250uF/60VW electrolytic
3 x 100uF/25VW electrolytic
2 x 100uF/6VW electrolytic
5 x 5uF/12VW electrolytic
2 x 0.22uF/100VW metallised polyester
1 x 0.33uF/100VW metallised polyester
3 x 0.1uF/100VW polyester
1 x .056uF/100VW polyester
1 x .047uF/100VW polyester
7 x 100pF polystyrene or ceramic
2 x 47pF polystyrene or ceramic
2 x 47uF/25VW
1 x 47uF/50VW

RESISTORS
(all ½ watt, 10% tolerance)
4 x 1M, 3 x 150K, 2 x 120K, 2 x 100K, 10 x 10K, 3 x 2.2K, 2 x 1.5K, 1 x 1K, 2 x 680 ohms, 2 x 560 ohms, 2 x 270 ohms, 1 x 10 ohms, 1 x 4.7 ohms
5 x 10K (log) potentiometers

MISCELLANEOUS
Mains cord and plug, shielded cable, hook-up wire, ferrite rod, printed circuit pins (2), screws, nuts, lockwashers, solder.
Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used, providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.

Nuclear medicine and the gamma camera

The last twelve months has seen a dramatic increase in the use of nuclear medicine in Australia. Aided by the continual advance of electronics, the gamma camera has emerged as one of the most important diagnostic instruments available to the medical profession.

by Paul T. McQuarrie*

The science of nuclear medicine deals mainly with obtaining diagnostic information by injecting a patient with a radioisotope and tracing its path through the body. The isotope's accumulation in various organs can show the physician any abnormalities present.

The patient is placed under the gamma camera, which produces photographic recordings of organs and areas of the body containing gamma-ray-emitting isotopes. The photograph obtained is an accumulation of dots displayed on a cathode ray tube, each dot representing a radioactive decay event occurring within the body.

Over a short period of time, hundreds of thousands of dots appear and are recorded on film. Two photographic records are normally made. One is made with a triple lens camera equipped with a Polaroid film back. The three lenses provide three exposures, f8, f11, and f16. The photograph from this camera is ready for viewing about about 15 seconds after the study is completed.

The other record is made with a 35mm camera on conventional film. This system provides somewhat more exposure latitude than the one using Polaroid film and, together, the two systems provide maximum diagnostic information.

If an abnormality such as a tumour or lesion in a brain is present, it can appear as a much brighter region of dots as more isotope is absorbed by the tumour. In the case of a liver, the opposite can be true—i.e. a tumour can appear as a dull area due to very little radioactivity being present.

The isotopes injected are gamma emitting substances and the gamma rays pass from the patient through a parallel-hole collimator (figure 1) where they enter a clear sodium iodide crystal. The crystal is disc shaped, half an inch thick and 10in in diameter.

The collimator is a block of lead of the same diameter as the crystal and about 1½in thick. It is drilled with a large number of parallel holes (typically 4000.) It is mounted against the face of the crystal and the holes run at right angles to this face.

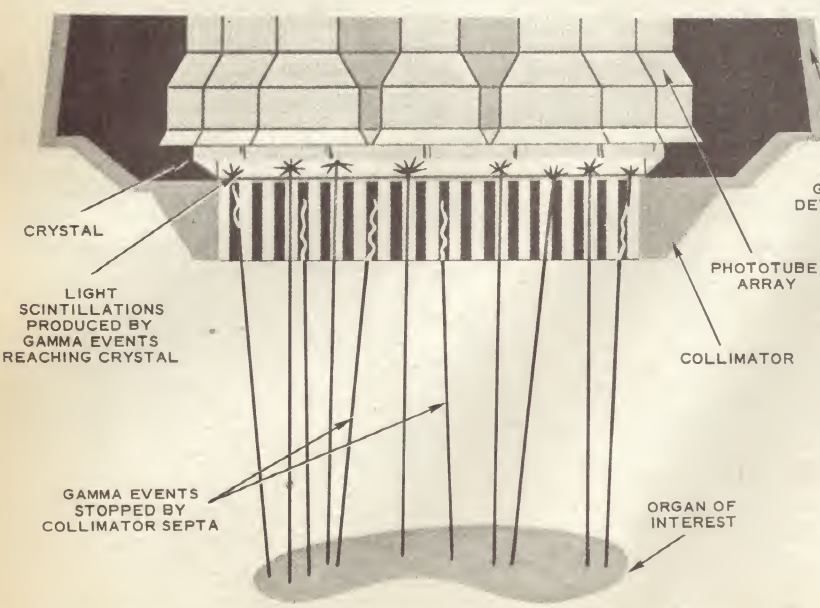


Fig 1. The detector head of the camera system. Note the action of the collimator, which accepts only those particles arriving a right angles to its face.

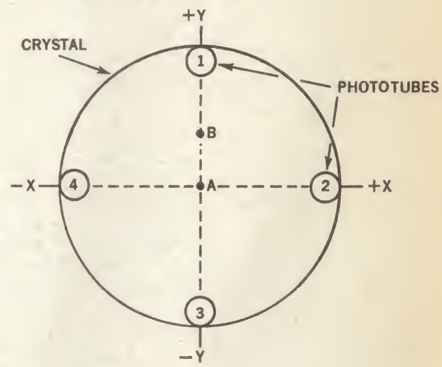


Fig 2. Explanatory diagram showing how a minimum of four photo tubes can determine the position of a light flash on the crystal.

The collimator functions in lieu of a focusing facility. Since the crystal cannot be placed in contact with the organ under observation, but must usually be several inches away from it, the natural tendency for the particles to radiate in all directions would produce a meaningless image. It is desired that the crystal respond only to those particles which approach it at right angles to its face. The collimator achieves this simply because any particle which enters a hole at an angle to it, will be absorbed by the wall before it reaches the crystal.

The gamma rays which reach the crystal are absorbed by it and the energy is transferred to become minute flashes of light (photons) at the point in the crystal directly above the location where the gamma ray emerged from the patient.

The photons are seen by a hexagonal array of 19 photomultiplier tubes sitting flush on the upper surface of the crystal. The lower surface of the crystal is sealed to visible light by thin metal foil, thus the light reaching the photomultiplier tubes originates solely from the flashes within the crystal.

Information regarding the position of the scintillation in the crystal is taken from the ratio of the outputs of each of the 19 phototubes.

* Searle Nucleonics, a division of Searle Australia Pty Ltd, North Sydney, NSW.

The camera in operation. The detector head is on the left, against the patient's head, and part of the control panel, with camera, on the right.

Theoretically, only four phototubes would be required to determine position. Four phototubes placed at the extremities of two diameters at right angles drawn across the crystal (see figure 2) would be sufficient to determine the position of any scintillation of light within the circular crystal.

If the light pulse occurred at point A, the centre of the crystal, each tube would record the pulse equally and the outputs of each tube would be the same. The point A is the only position in the crystal where the outputs of all four tubes would be the same.

Similarly, at point B, tubes 2 and 4 would give equal outputs, whereas tube 1 would give a larger output, and tube 3 a smaller one than tubes 2 and 4. Point B is the only position in the crystal where this relationship between the outputs exists.

Noise levels in phototubes, however, sometimes approach the low signal level from light pulses seen on the far edge of the crystal. For this reason, more than four tubes are used, in this case 19, to overcome the problem of low signal level.

The output of each tube is fed to individual preamplifiers, the signal is passed through a resistive matrix, and the X and Y directional components are extracted. The signal then leaves the "head" via four lines +X, -X, +Y, -Y. (Figure 3).

Entering the console the signal is split, one part being used to provide positional information, and the other part to provide total energy information concerning the original disintegration.

The total energy information path goes to a summing circuit, where the four signals are arithmetically summed. The resultant signal is directly proportional to the gamma energy of the original disintegration.

The system is required to differentiate between legitimate and false pulses. False pulses may be due to photomultiplier noise, or other rays given off by the isotope but which are not required for the study.

The energy of the gamma particles, as sensed by a pulse height analyser, is used to provide this discrimination. The analyser uses tunnel diodes as upper and lower discriminators and for the pulse to emerge from the analyser the pulse height must be more than the lower discriminator, yet less than the upper discriminator.

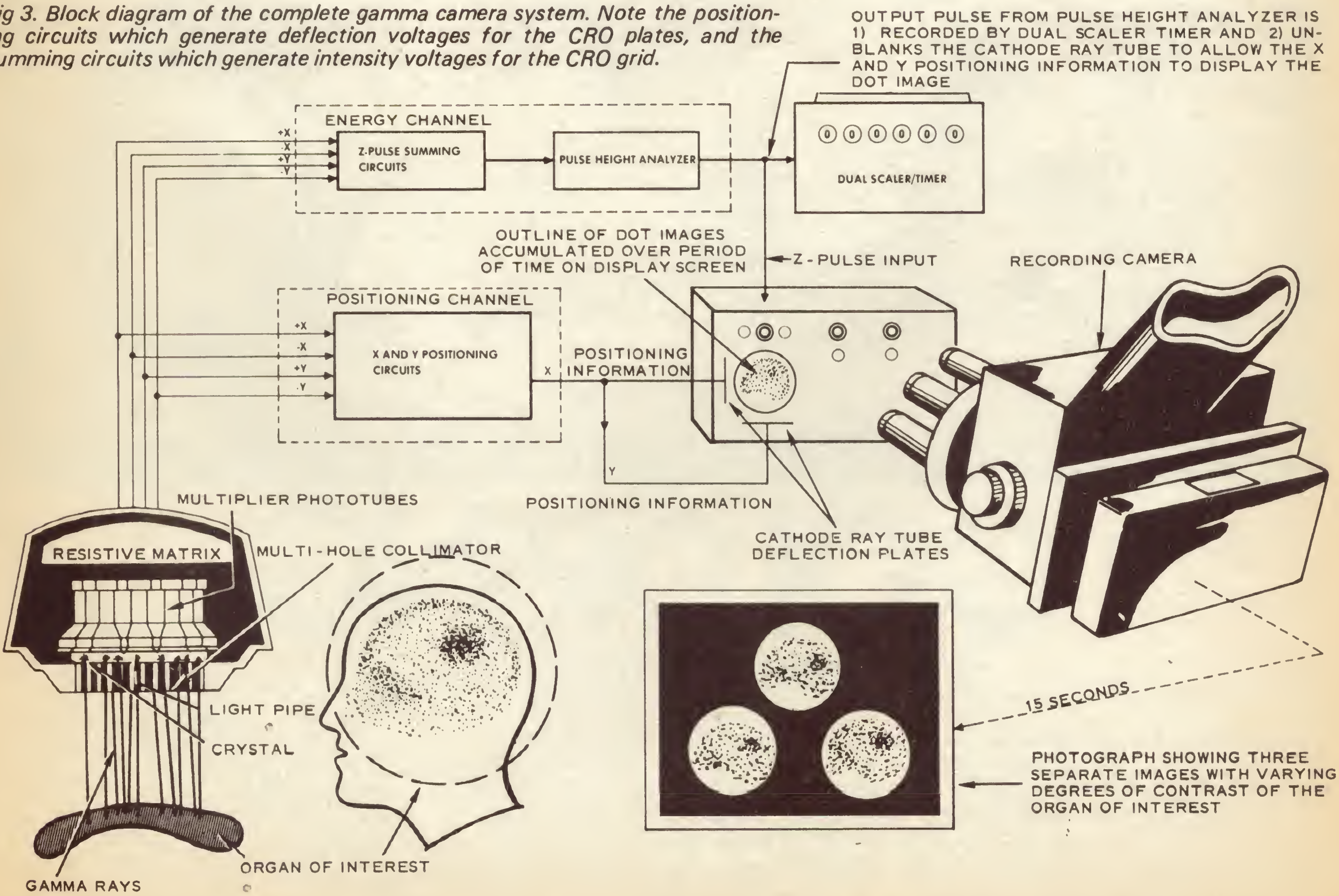
The effectiveness of this system is aided by the fact that, in many newly designed synthetic isotopes, a large percentage of the disintegration occurs at the one energy level, or very close to it.

Output from the pulse height analyser goes to a scaler and to the control grid of the CRT. The CRT is normally turned off or "blanked", and the pulse from the analyser turns the tube on.

The positional information goes to the X and Y positioning circuits. The four signals are amplified individually and fed to differential amplifiers. Output from these is applied to the X and Y deflection plates of the CRT.

Thus, as the energy channel turns on the CRT to produce a spot on the screen, the

Fig 3. Block diagram of the complete gamma camera system. Note the positioning circuits which generate deflection voltages for the CRO plates, and the summing circuits which generate intensity voltages for the CRO grid.




GOLDRING ACCESSORIES FOR EVERY SOUND NEED

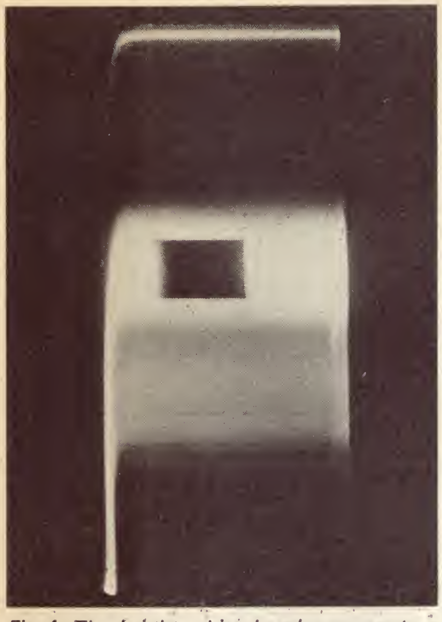


Fig 4. The bright white band represents a large number of events at that energy level. The black patch is the "window" which observes this particular energy level.

positioning circuits apply the appropriate voltages to the deflection plates to correctly locate the spot, relative to the original position on the crystal.

Each pulse that reaches the CRT is also counted on one of two separate scalers. The duration of each study is determined by either a timer, or, more commonly, by nominating the total number of dots required on the film.

The latter method is preferred because the results obtained are independent of the isotope dose administered, and, to a lesser extent, independent of organ and patient size.

Before a study can be performed, the system must be adjusted so that disintegrations due to the isotope will pass through the pulse height analyser. To do this a "Spectrum" mode is provided which gives a visual presentation of all the pulse heights, both wanted and unwanted, on the CRT. (Figure 4.) The black rectangle represents the "window" through which the accepted pulses will pass, the top edge depicting the upper discriminator and the bottom edge the lower discriminator.

The bright band in figure 4 represents a large number of events occurring at that particular energy. The window bandwidth can be adjusted from 0% to 35% of the isotope energy peak.

To adjust the pulse height, an "Isotope Peak" control varies the high voltage applied to the photomultiplier tubes on the crystal. This varies the output from each tube, so that the band can be centred over the window. All of the pulses passing through the window are fed to the CRT from which the photographic recording is made.

Normally, organs are studied from more than one position. In the case of brain studies, four views are taken, posterior (back of head), anterior (front of head), and left and right lateral. Occasionally a vertex (top of head) view is made.

Gamma cameras will be as common as X-ray . . .

From these views, accurate positional information of lesions is obtained. Figure 5 shows a tumour in the frontal area of the brain. Taken about two hours after injection of a radioisotope, the photograph shows the brain cavity as a dull area with the tumour absorbing more isotope and consequently appearing as a bright region.

The ability of the isotope to concentrate in a tumour is a characteristic of the compound in which the isotope is contained. For brain studies, this compound is sodium pertechnetate, containing technetium.

Technetium is a manufactured isotope derived from molybdenum and is used in various compounds for studies of most organs. Produced at the Australian Atomic Energy Commission's establishment at Lucas Heights in Sydney, the compounds containing the isotope are prepared daily and delivered to the various hospitals around the city.

The isotope of technetium is a short lived one, with a half-life of six hours, giving a high photon yield, and making for short study times. Also, because of the short half-life, the radiation dose is insignificant to the patient.

The isotope is available at present in four different compounds, of which three are specific to particular organs. Sodium pertechnetate goes to most organs in the body and is used mainly for brain studies. Figure 6 shows a lung study using macro-aggregated ferrous hydroxide (MAFH) containing technetium. The MAFH particles are somewhat larger than the diameter of the capillaries in the lungs. As blood goes from the veins to the lungs (through the heart), the particles are removed from the blood in the lungs, and go to no other organ in the body. The particles decompose after a short time in the lungs and are removed.

Figure 7 shows a kidney study using technetium gluconate. The gluconate is filtered from the blood by the kidneys and passes to the bladder.

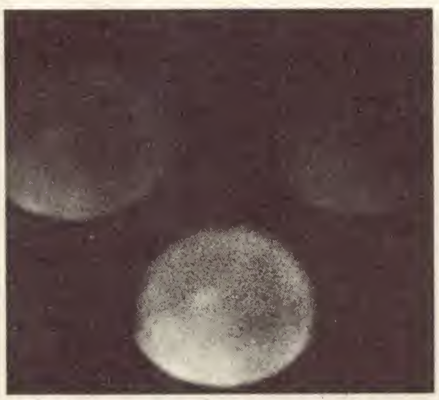
Other compounds containing different isotopes are used for less common studies, such as indium ^{113} chloride for placentas (in pregnancies) and fluorine ^{18} in bone studies.

In some organ studies, such as lungs and kidneys, it is useful to determine relative function of each half of the organ. To accomplish this, the camera provides a facility to split the field of view down the centre, electronically, and the pulses from each half are counted in separate scalers. Thus, at the end of the study, the number of counts in each scaler gives a ratio of the performance of one half of the organ to the other. This is particularly useful in kidney studies.

Another useful facility of the camera is to record the study continuously via a videotape recorder. The complete study can then be played back at a convenient time and the photographic recordings obtained.

An advantage of this facility is that areas of interest may be constructed so as to view the information returning from the tape in selected areas only, making for more informative results.

As the science of nuclear medicine is recognised better as a non-traumatic, high information diagnostic procedure, more gamma cameras will appear in hospitals around Australia, when studies under the camera will be almost as common as present day X-ray studies.



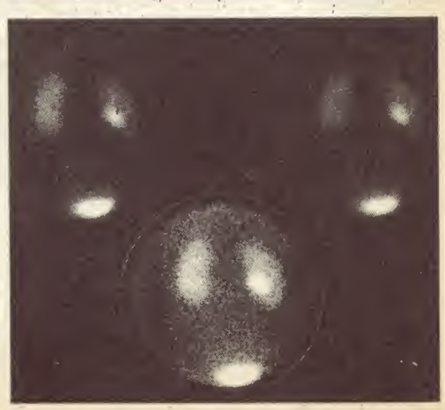


Fig 5 (above). View of a brain containing a tumor. The tumor appears as a bright spot near the centre. Bright area at the bottom represent facial tissues, etc.

Fig 6. (above right) Front view of a pair of lungs showing a non-functional (dark) area in the lower part of the right lung.

Fig 7 (right). Front view of a pair of kidneys, with the bladder below them. A blockage in the (patient's) left ureter shows as a bright patch.

(Gamma camera photographs on this page are reprinted by courtesy of the Royal Prince Alfred Hospital, Sydney.)

THE SERVICEMAN

Miniature Radios — A Challenge

What is your approach when a customer produces a foreign brand miniature radio which "doesn't go"? Do you accept the challenge, or do you consider they are not worth handling? This is one of the problems discussed this month.

There is no doubt that these little devices, particularly the odd types brought back from overseas, present a sticky problem for the serviceman. Unless the fault is a very elementary one, servicing may be quite uneconomic.

On the one hand, they are purchased for only a few dollars overseas, and the owners invariably tend to relate service charges to the purchase price. Against this, replacement parts are generally as scarce as the proverbial hens' teeth, so that repairs, if possible at all, invariably involve time consuming improvisations. As a result, costs mount rapidly, often to a figure far in excess of the original price.

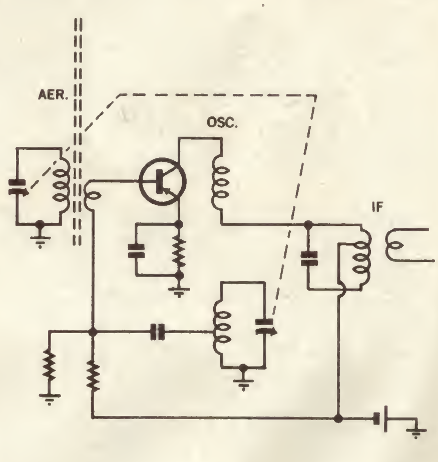
Only if the customer is fully aware of this, and willing to meet these costs, is it worthwhile the serviceman even looking at the set.

For all these reasons, most servicemen tend to shy away from them. A few, on the other hand, seem to relish the challenge, and gear their working procedures to cope with the problems.

This is no simple task. Among the things to be organised are supplies of spare parts, either from the importers or, in many cases, directly from overseas; service data, again often directly from the makers; test equipment, such as regulated and metered power supplies; and, most important of all, as much background and general knowledge about the circuits and components involved as possible. Typical of this latter requirement is the need to know which components are interchangeable between one brand and another, or what locally made components, including transistors, can be substituted for those originally employed.

Among the few who have committed themselves in this manner is a fellow serviceman whose name readers may have already seen in advertisements in this magazine — Peter Broughton. At my suggestion he plans to select some of his more interesting cases and submit them for publication from time to time. Here is his first one, a typical example of the problems I have outlined.

The customer was a dear old lady who



The autodyne circuit of the set in this story. With minor variations it is typical of most current designs.

begged me almost literally with tears in her eyes, to repair a small portable radio. It transpired that she had recently returned from an overseas trip and had brought back six of these sets; one for each of her six grandchildren. They had cost her something like four dollars each.

When one of them had subsequently failed she had taken it to another service organisation who, having examined the set, advised that they were unable to repair it because they did not have the appropriate spare part. However, they pointed out that, had they been able to do the job, it would have cost around $15. She added, "They said I would be mad to pay out that kind of money to repair something which only cost four dollars in the first place."

As diplomatically as I could, I was forced to agree with them. Still, for what I suppose can only be described as sentimental reasons, she wanted the set fixed. The best I could promise was that, if I could fix it, it should not cost the figure previously quoted, but could still cost more than the new price. She accepted this situation and told me to see what I could do.

The set was a fairly standard design, which I have seen under various brand names, made in both Hong Kong and Taiwan. A significant characteristic is that they all operate from a single UM 3A cell; a total supply of 1.5 volts. It was only because I had some knowledge of the design that I felt reasonably confident that I could get it going again.

On switching the set on, my first reaction was that it was quite lively and rearing to go. The only thing wrong was that it wouldn't receive any stations. The most likely explanation was that the local oscillator had failed.

There are a number of simple tricks one can use to confirm such an assumption. One is to use the signal generator as a substitute for the local oscillator. I usually set the receiver to 2BL, couple the output of the generator loosely to the aerial circuit of the set, and set the generator to 2BL plus 455KHz. (740 plus 455 is 1195)

If the only fault is local oscillator failure, the set will bring in signals, and not only from 2BL but from other stations as the signal generator is set to the appropriate frequency.

Another trick is a variation on this, in that a second set is used in place of the generator. In this case the two sets can usually be coupled quite adequately by simply arranging that the two aerial coils and rods are as close as possible.

Satisfied that it was the local oscillator, I checked off the likely causes; shorted oscillator gang, shorted trimmer, open circuit loop winding, no voltage on the base or the transistor, or our old friend an open oscillator coil.

A quick visual check revealed some "claw marks" around the oscillator coil. Pretty obviously, this was where someone else had been working, almost certainly the previous serviceman the owner had mentioned. A quick check with the ohmmeter confirmed my fears; the coil was open circuit between the tap and the chassis end of the base winding.

What does one do in a case like this? The set is not available on the local market and, as a result, I carry no spare parts for it, nor do I know of anyone who does. On the other hand, it is a common problem, and I have developed a routine for tackling it.

Any possible solution is based on the fact that one autodyne circuit is very much like another, apart from a few minor differences, and one autodyne oscillator coil is, likewise, very like another — at least electrically. Unfortunately there appears to be very little standardisation among the Japanese manufacturers, and the five pin connections are likely to be in one of the umpteen possible combinations. Similarly, the size and mounting arrangements may differ.

In cases like this I am forced to salvage what I can from sets already discarded for other reasons. And where foreign sets are concerned I never throw anything away. From this stock I select the coil which is as close as possible in shape and size to the

original.

Then one has to determine the correct pin connections. The individual windings can be identified with an ohmmeter, as can the tapping on the tuned winding. To identify the tap, first find which two of the three terminals presents the highest resistance, usually from 5 to 12 ohms. Since this must represent the total winding, the remaining terminal is the tap. Finally, determine which terminal is closest to the tap in terms of resistance. This will be the "earthy" terminal, and the remaining one must connect to the oscillator gang.

By this means this winding can be correctly connected, leaving only the feedback winding to determine the correct phase. Of course, by Murphy's Law, this will always be connected the wrong way the first time, even if one tries to circumvent this by connecting it the way you think it should be connected the second time, the first time.......

This set set was no exception, and I had to transpose the connections before it would work. But it did work, although sounding a little sick. From then on it was mainly a matter of alignment to put back into place the slugs which had been fiddled with by the previous serviceman.

Why people fiddle with IF and oscillator slugs when they can't find any ovbious fault in a set is beyond me. Yet they do, and surprisingly often. In fact, one of the first things I look at in these little sets is the IF transformers. If the slugs have been wound out further than their normal position, I reckon it's pounds to peanuts that someone has been having a fiddle. Since this kind of fiddling never cured a dead set to my knowledge, all they succeed in doing is creating a second fault on top of the original one.

Anyway, the set came good progressively as I peaked up the various sections and when I had finished it was performing exceptionally well.

As for the dear old lady — well, she seemed happy beyond belief, just to have the set working again. Even if it did cost her more than the price of the set.

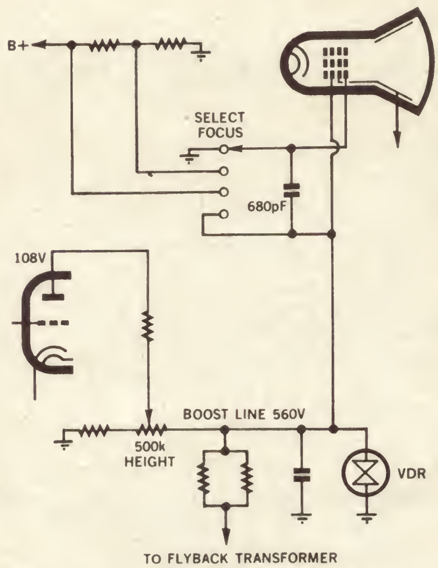
Oh well, happiness is many things to many people.

From my own service bench I have a story about a domestic TV receiver. This was a National set, model TW520, designed in Japan but assembled in Australia. It is a valve set equipped with a 25in (635mm) picture tube. The symptoms were lack of picture height, there being about one inch of black border top and bottom. While it was possible to restore most of the height by means of the height control, this left nothing to spare and was obviously not the answer. In addition, it upset the vertical linearity quite seriously.

In the normal way my first test would be to replace the valve or valves associated with this part of the circuit. In this case it was a triode-pentode as vertical oscillator and output valve respectively, but the type number, 18GV8, had me beaten. In fact, most of the valves in the set would have been beyond my stock, having been selected to suit a heater circuit operating directly from 110V. The Australian version of the set is equipped with a transformer to suit the 240V mains.

For this reason I decided to make a preliminary voltage check first. If this showed no discrepancies from the service manual, I would order the necessary valves. Even if they ultimately proved unnecessary, they would be useful ones to have on hand.

My first check was at the plate of the triode (oscillator) section. According to the circuit this should have been 108V but was only 90. While enough to make one suspicious, it was hardly enough to regard as a major symptom. My next check point was at the hot end of the "HEIGHT" pot which, from the circuit, should have been at 560V. Instead it was only 450.



The relevant portion of the TV receiver circuit, showing the 680pF capacitor which proved to be faulty.

This was a much more tangible discrepancy, particularly as a closer examination of the circuit confirmed that this was virtually the B plus boost supply line.

As a first check I disconnected this boost line from the height pot and noted that it remained low. Whatever the fault was, it didn't seem to be associated with any excessive drain around the vertical oscillator.

So what was next? I traced the boost line through the circuit and came to pin 3 (anode 1) of the picture tube. The diagram showed a 680pF capacitor connected from this line to the line from pin 4 (anode 3 or focusing anode). This line, in turn, went to one of four terminals providing a selection of focusing voltages, being zero (chassis), two values derived from the HT line, and the boost line. In this case the chassis terminal had been used.

The 680pF capacitor had me intrigued. It was a rather unusual component in that part of the circuit and I couldn't figure out what it was for. More to the point, I began speculating on the effects if it was leaky. With one end connected to chassis and the other end to the boost line, any significant leakage could be a serious drain on the boost supply.

Because it was easiest to do, I simply shifted the focusing electrode lead from the chassis terminal to the boost line terminal, thereby putting the two ends of the capacitor at the same potential. The effect was immediate. The focus may not have been optimum, but the picture jumped back

(Continued on Page 113)

Microwaves for the radio amateur — 2

The second of a short series of articles written in an attempt to stimulate more activity by radio amateurs on the microwave bands. In this chapter the author deals with waveguides and the way in which electromagnetic energy propagates along them.

by DES CLIFT, VK2AHC*

In the first article reference was made to various terms and items connected with microwave engineering. As some readers may be unfamiliar with these, a brief explanation of the more common ones follows.

In the part of the electro-magnetic spectrum under consideration, waveguides are frequently encountered. Usually waveguides are hollow rectangular tubes, and are basically used for conveying microwave energy from point A to point B with as low a loss as possible. Normally they are drawn tubes of brass, copper, aluminium or silver, but can be fabricated by milling or electroforming processes. There are important variations such as semi-flexible and flexible rectangular, double or single ridge, and circular waveguides. All, however, possess similar properties and operate in more or less the same manner.

Table II lists some of the waveguides that are used, ranging from the higher UHF bands right up to the region where radio and infra-red light waves merge. This is quite a large slice of the spectrum and, although their use at either end of this range is reasonably specialised, about half of the range is in very wide use commercially. Note that 300GHz (1 millimetre wavelength) is about the shortest radio wave used. For comparison the longest infra-red light waves (0.4 millimetre wavelength) have a frequency of about 900GHz.

At the lower frequencies the size of the waveguide becomes impractical. Very conveniently, at these frequencies the losses in the coaxial cables are still reasonably low. The WR 2100 type is about the largest size of tube used in practice, and this has similar dimensions to the small air ducting seen in offices and industry.

At the high frequency end, the limitations are mechanical, and also the difficulty in producing the energy itself is no small problem. Amateur use of waveguide is, as has been pointed out, usually limited to the 10,000 MHz band.

There are various systems of numbering waveguides, as shown in Table II. The UK has adopted the "WG" numbering system, starting at 00 up to 32 or so.

In the United States there are three main systems used:

(a) EIA system, where each size is given a WR number which is the inside long dimension in hundredths of an inch, i.e., WR2100 is 21in x 10½in inside.
WR10 is 0.1in x .05in inside.
WR90 (standard X band guide) is 0.9in x 0.4in inside.

(b) JAN types, having RG numbers in no logical sequence, but with separate numbers for different materials (brass, copper, aluminium, etc).

(c) I.E.C. system, in which the numbers are ten times the centre frequency in thousand of megahertz (GHz) of the recommended band of use, ie, IEC100 is 10 x 10GHz. Thus WG16, WR90, and IEC100 are the same physical size and are suitable for 10,000 MHz.

Various features should become apparent as a result of a perusal of Table II:

(1) That a large number of tubes is required to cover the whole range.

(2) That the size of the tube varies considerably, the size in fact being proportional to the wavelength. A lower limit of frequency could be said to be set by the size becoming impracticably large.

An interesting point, which results from this, and is of very great practical use, is that since a waveguide is frequency sensitive, it can be used as a highly accurate and reliable attenuator. Such an attenuator, known as a "waveguide beyond cut off" type is produced by simply using a waveguide somewhat smaller than would be normally used at the operating frequency. The operation of such a device will become apparent as a result of the discussions following.

It may seem strange that it is necessary to vary the dimensions of waveguide to suit the frequency used, and that waveguide of a certain size can attenuate signals. After all, there is no similar restriction (within limits) when open wire lines or coaxial cables are used, and at first sight the same form of electromagnetic wave motion is used to propagate energy throughout the spectrum.

It is reasonable to assume therefore that waveguide operates in a different manner to coaxial cable, and open wire line.

Readers are probably aware that in free

TABLE II: WAVEGUIDE SIZES

Internal Dimensions (Inches)	Frequency Range (GHz)	Official waveguide designations				Band Letter
		U.K. (RSCS)	U.S.A. (EIA)	U.S.A. (JAN)	U.S.A. (IEC)	
21.0 x 10.5	0.35-0.53	WG0	WR2100			
18.0 x 9.0	0.41-0.625	WG1	WR1800	RG-201/U		
15.0 x 7.5	0.49-0.75	WG2	WR1500	RG-202/U		U.H.F.
11.5 x 5.75	0.64-0.96	WG3	WR1150	RG-203/U		
9.75 x 4.875	0.75-1.12	WG4	WR975	RG-204/U		
7.7 x 3.85	0.96-1.45	WG5	WR770	RG-205/U		
6.5 x 3.25	1.12-1.7	WG6	WR650	RG-69/U	R14	L
5.1 x 2.55	1.45-2.2	WG7	WR510		R18	
4.3 x 2.15	1.7-2.6	WG8	WR430	RG-104/U	R22	
3.4 x 1.7	2.2-3.3	WG9A	WR340	RG-112/U	R26	S
2.84 x 1.34	2.6-3.95	WG10	WR284	RG-48/U	R32	
2.29 x 1.145	3.3-4.9	WG11A	WR229		R40	
1.872 x 0.872	3.95-5.85	WG12	WR187	RG-49/U	R48	
1.59 x 0.795	4.9-7.05	WG13	WR159		R58	C
1.372 x 0.622	5.85-8.2	WG14	WR137	RG-50/U	R70	
1.122 x 0.497	7.05-10.0	WG15	WR112	RG-51/U	R84	X
0.9 x 0.4	8.2-12.4	WG16	WR90	RG-52/U	R100	
0.75 x 0.375	10.0-15.0	WG17	WR75		R120	J
0.622 x 0.311	12.4-18.0	WG18	WR62	RG-91/U	R140	K
0.510 x 0.255	15.0-22.0	WG19	WR51		R180	
0.420 x 0.170	18.0-26.5	WG20	WR42	RG-53/U	R220	
0.340 x 0.170	22.0-33.0	WG21	WR34		R260	Q
0.280 x 0.140	26.5-40.0	WG22	WR28	RG-96/U	R320	
0.224 x 0.112	33.0-50.0	WG23	WR22	RG-97/U	R400	
0.188 x 0.094	40.0-60.0	WG24	WR19		R500	
0.148 x 0.074	50.0-75.0	WG25	WR15	RG-98/U	R620	
0.122 x 0.061	60.0-90.0	WG26	WR12	RG-99/U	R740	
0.100 x 0.050	75.0-110.0	WG27	WR10		R900	
0.080 x 0.040	90.0-140.0	WG28	WR8	RG-138/U	R1200	
0.065 x 0.0325	110.0-170.0	WG29	WR7	RG-136/U		
0.051 x 0.0255	140.0-220.0	WG30	WR5	RG-135/U		
0.043 x 0.0215	170.0-260.0	WG31	WR4	RG-137/U		
0.034 x 0.017	220.0-325.0	WG32	WR3	RG-139/U		

*6 Gilles Crescent, Dee Why, NSW 2099

space, what is called a transverse electromagnetic or TEM wave provides the means of transmission. Inside a coaxial cable, a strip line, or an open wire line there is a similar wave form, modified slightly by the dielectric material and the geometry. In these cases it is usually referred to as the "principal" wave. The E and H vectors are perpendicular, and both are perpendicular to the direction of propagation. Fig. 3 illustrates this point.

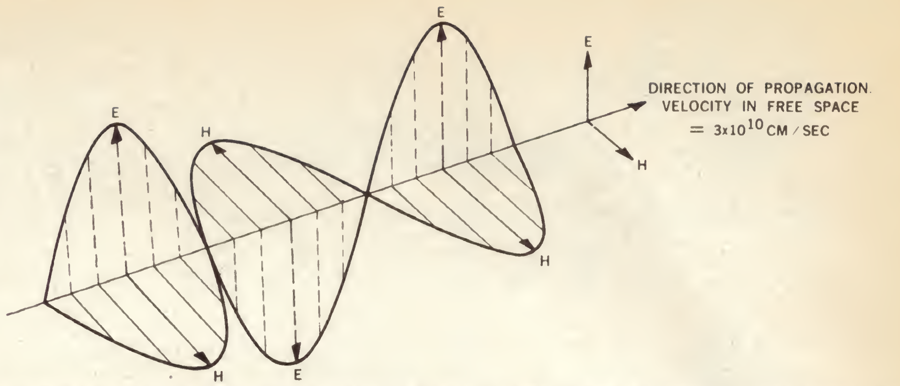


Fig.3 above shows a transverse electromagnetic (TEM) wave, as found in free space. By convention the E-field defines the polarisation.

In a waveguide a wave motion that again has E and H perpendicular is also involved, but in this case there are also components of either E or H which are in the direction of propagation, and it is because of this that:

(i) The lossy dielectric (loss proportional to frequency) and the less lossy inner conductor (loss proportional to square root of frequency) of the coaxial cable can conveniently be dispensed with.

(ii) A wave motion which requires a frequency sensitive conducting system has been produced.

One of the best ways of visualising the type of wave motion existing in a waveguide is to consider two coherent TEM waves interfering, as detailed in Chapter 2 of the book "Wave Guides" by L. G. Huxley. (Cambridge Press, Modern Radio Techniques series). This method shows the formation of the required waveguide "mode" of transmission by algebraically summing the fields at various points in an area in which these two coherent TEM waves pass in different directions.

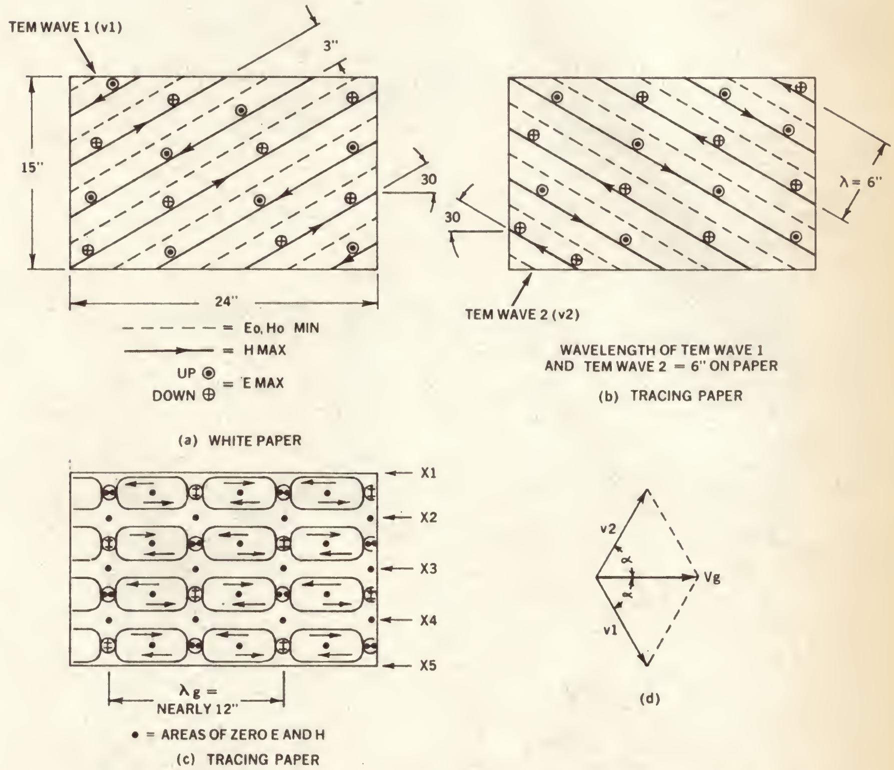


Fig. 4 SYNTHESIS OF METHOD OF TEo1 (H WAVE) PROPAGATION IN A WAVEGUIDE

First, however, it is essential to remember certain basic conditions (referred to as "boundary conditions") which must be fulfilled in order for an electric or magnetic field to be able to exist at a restricting boundary. These are:

(i) When an electric field meets a boundary, it must be at right angles to it.

(ii) When a magnetic field meets a boundary it must be tangential to it.

Usually, but not always, the boundary is a metallic conducting surface. Thus, the simple TEM wave of Fig. 3 can quite well be enclosed between two parallel plates, as in a strip line, but cannot exist if a further two plates are added to complete a rectangle (ie, to produce a waveguide) since the conditions above are then violated.

In order for the electromagnetic energy to be able to exist and propagate down a closed waveguide pipe, it must really consist of two TEM components which are both effectively propagating at a certain oblique angle to the waveguide axis. In effect the two components "bounce" along the interior walls of the waveguide, mutually interfering in such a way that they cancel in the planes of the two walls which would normally be parallel to the E field of a single TEM wave.

The writer has evolved a relatively easy method of putting over this idea to amateurs or groups with widely varying mathematical and practical knowledge and this is recommended to the reader who would really like to understand the various aspects of waveguide operation. It involves the use of three equal size sheets of paper — one white, the other two tracing.

The first TEM wave component in cross section is drawn as in Fig. 4(a) on a sheet of white drawing paper about 24in x 15in. This wave, as noted previously, is moving in space with a velocity just under 3×10^{10} cm / sec. In these sections the oblique lines represent the magnetic field, with the thick lines for H max (H) and the thin dotted lines for H min (Ho). The circles represent the electric field, perpendicular to the paper, marked in the usual conventions. E is the maximum, Eo is the minimum.

Note that the maxima and minima of the magnetic and electric fields occur together. Thus the solid lines really represent not only sideways cross-sections of planes of maximum magnetic field intensity, but also end-on cross-sections of planes of maximum electric field intensity. Similarly the dashed lines represent planes where both the magnetic and electric fields are at minimum intensity.

The second TEM wave component is produced on tracing paper, cut to the same size, by lightly copying only the spacing and lines of the first. This sheet is then reversed and a second series of thick and thin lines, and dots and crosses is drawn (Fig. 4b). In this way equal sizes of paper are used from the outset, and tracing simplifies the duplication of spacings and angles.

The third sheet of paper (also tracing paper) is now placed over the first two. It should become apparent, after an initial observation, that there are various places where the electric fields add, ie, where ⊙ and ⊙ lines cross, or ⊗ and ⊗ lines cross. There are also various places where the electric fields cancel, ie, where ⊙ and ⊗ lines cross.

In fact it will be found that there are regularly spaced planes (represented by horizontal lines on our diagram) over which the electric fields everywhere cancel. In between these planes the magnetic fields tend to interact in such a way that they form themselves into chains of closed loops, the sides of which are tangential to the planes of zero electric field intensity. The ends of the magnetic loops interlock, and it is at these

points that the electric fields add to produce maxima.

If we remember the boundary conditions, it should be evident that the planes of zero electric field intensity produced by the interaction of the two TEM wave components would be ideal positions for conducting waveguide walls. These positions are indicated in Fig. 4(c) as X1, X2, . . . X5. Conducting planes placed at any two of these positions could be used to confine the wave energy in between, without in any way conflicting with the boundary conditions.

Generally the waveguide walls coincide with two adjacent zero-field planes, so that they enclose a single "chain" of the electromagnetic loops. This is the situation for the basic or "principal" mode of waveguide propagation; it is possible for the waveguide walls to enclose two or more chains of loops, but this corresponds to "higher order" propagation modes.

At this stage we should perhaps look at the significance of the angles formed between the direction of propagation of each of the basic TEM wave components and their "chain-wave" resultant which propagates along the waveguide (horizontally from left to right in Fig. 4). In fact the two angles are the same.

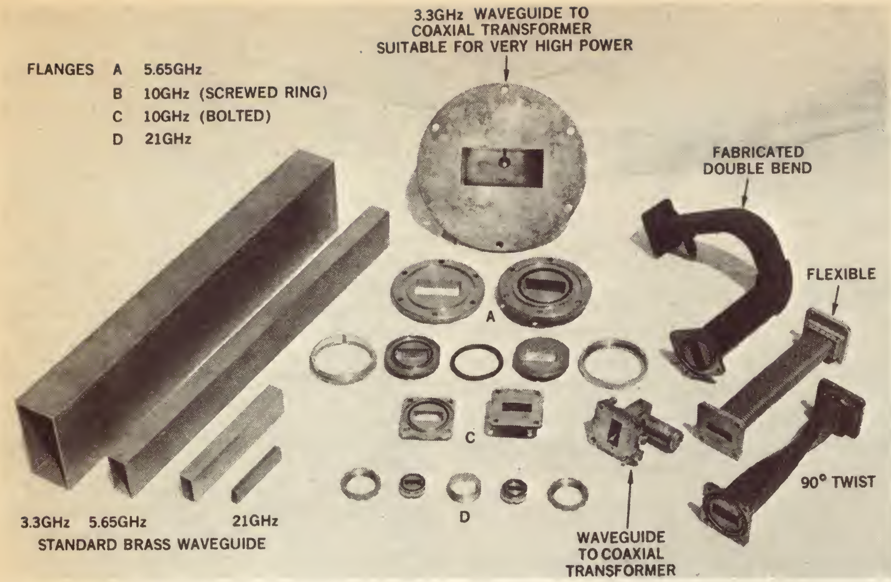
From the experiment of Fig. 4 it should become apparent that this "bouncing angle" (designated alpha) and the wavelength of the original TEM wave components (designated lambda) together determine the distance between the planes of electric field cancellation. For a given distance between the waveguide conducting walls, and for any particular wavelength of the electromagnetic energy, there will only be one angle alpha which will result in the distance between the planes of field cancellation corresponding to the waveguide height, and this is of course necessary if the boundary conditions are to be satisfied.

What does this really mean? Simply that in order to exist in the closed confines of a waveguide, the electromagnetic energy must effectively split itself up into two TEM wave components which bounce back and forth between the waveguide walls at an angle rigidly determined by the frequency. In fact the angle is inversely proportional to frequency — the higher the frequency, the smaller the angle, and conversely the lower the frequency the larger the angle.

In the direction of increasing frequency there is virtually no limit — in other words, there is basically no reason why energy of extremely high frequency cannot exist and be propagated along any waveguide, even one with large dimensions. There may be practical difficulties in generating the energy and getting it into and out of the waveguide, but no fundamental barriers.

On the other hand, there is a fundamental barrier in the direction of decreasing frequency. For any given waveguide, the angle alpha must increase as the wavelength of the energy is increased. A limit is reached when alpha finally reaches 90°: at this angle, the distance between the planes of electric field cancellation becomes equal to a half wavelength.

At this frequency the boundary conditions can still be satisfied (just!), so that the electromagnetic energy can still exist in the waveguide. But there is one problem: as the two TEM components must bounce back and forth at an angle of 90° to the waveguide axis and walls, they have no component of



A collection of assorted waveguide fittings and hardware.

velocity along the guide. So the energy is unable to propagate along. For this reason the frequency where one half-wavelength equals the height of the waveguide is known as the "Cutoff frequency" (fc) for that waveguide.

It is not possible for energy to be confined in a waveguide if its frequency is below the cutoff frequency for that guide, simply because there is no way in which it can bounce between the walls without its electric field component being short-circuited. In other words, the boundary conditions cannot be met.

From Fig. 4(c) it may be seen that the energy travelling along the waveguide has an effective wavelength equal to two of the magnetic loops. This is known as the "waveguide wavelength" (λg). This length is always greater than the free-space wavelength, and the ratio between the two increases as the bouncing angle increases — ie, at frequencies approaching cutoff.

This wavelength is of great importance as it is the one that is actually measured with a slotted waveguide and the one that controls the physical dimensions that components are designed around. Fortunately for amateurs, highly accurate measurements of λg are seldom required for amateur work.

Because the waveguide wavelength is always longer than the free-space wavelength, the theoretical "phase velocity" with which the energy propagates along a waveguide is greater than the speed of light. But the actual velocity of propagation of the energy is in fact always lower than the speed of light, because the components making up the wave are bouncing back and forth as well as moving along. In other words, the "chain of loops" moves along the guide only at a rate corresponding to the components of the original TEM wave velocities in the direction of the waveguide axis. See Fig. 4(d).

In fact the actual velocity of propagation is proportional to frequency, for a given guide, and reduces as the frequency is lowered. As the cutoff frequency is approached, the velocity reduces in an exponential manner, and finally falls to zero.

The two waveguide "top" and "bottom" walls that we have been considering so far constitute the smaller and critical dimension. Another main factor controlling height is that it must be lower than that allowing the wave to propagate in the other dimensions. Otherwise a guide is produced which is energised in this plane as well, i.e. a dual mode waveguide, sometimes used in practice. The height must also be kept reasonably high so that the waveguide thus formed can carry as much power as possible, as the breakdown occurs across the narrow dimension. Usually the ratio of the sides is 2:1, but a few are odd values up to 2.5:1 and various special non standard types are in the region of 4:1.

In practice, therefore, a waveguide is specified for use over a frequency range of $\pm 20\%$ about a mean which is approximately 1.5 times the cut off frequency. This keeps the operating point well away from the cut off, and also away from the region where a second mode could exist. Looking at Table II shows that in alternate sizes, one starts where the other leaves off.

Various subscripts are added to indicate the form of wave in the tube. In the case considered, which as far as rectangular waveguide is concerned, is the one of real importance, if the tube is lying long side horizontal, say, and using the standard system of order of co-ordinates x, y, and z, the wave is referred to as TE10 (transverse electric, with one loop across the guide but with no loops vertical).

If it were turned through 90° so the short side was horizontal, it would be a TE01. But these are loosely used, however, to indicate the wave in question. This same process can be used to determine other modes of operation in tubes of various cross-sections.

Thus, a method of transmitting energy through a hollow tube is practical — there are, of course, some problems in joining up the bits and pieces, and in making attenuators, loads and other components so that all the energy is still contained in the tube, and is properly terminated.

The operation of one or two of these things will be described in the next article.

FORUM

Conducted by Neville Williams

When your hair has turned to silver . . .

However diverse humans may be in other respects, we have one thing in common — we are all growing older, and the ramifications of this are not always pleasant to contemplate. It may even interfere with our enjoyment of music and music reproduction!

The theme is introduced, this month, by a reader from Kingston Beach, Tasmania. He writes:

Dear Sir,

I would like to draw your attention to a problem, which I would assume that I share with many other readers of your magazine. I refer to the fact that our hearing curve drops away at the treble end as our age goes up.

I am 44, and it was recently found that my hearing is suffering in this way — something that I am assured is normal.

Indeed, by cupping my hands behind my ears, an instant improvement is noticed in the higher frequencies. I would be pleased if your magazine could devote an article to this, on some occasion.

What can be done within reason to diminish the problem when listening to hi-fi? A small tweeter closer to the ear than the main loudspeaker? It isn't only volume but direction.

Another matter on which I would like to see an article is the importance of absorbent packing in the loudspeaker enclosure and to what extent an improvement can be expected. My experiences tend to suggest that packing is undesirable but my faulty ears my be the cause of a wrong impression.

F.B. (Kingston Beach, Tas)

Unfortunately, the problem which F.B. speaks about is all too familiar to those of us who are on the wrong side of 35. It is a frustrating experience to be present in the lab when a younger person is observing the behaviour of a tweeter loudspeaker. The frequency goes up and up, then suddenly there is silence. Either the test is finished or the tweeter response has suddenly cut off.

But no. The test is still going on and so is the tweeter. What has cut off is the response of "maturing" ears!

If you walk over and turn up the gain in an effort to reassure yourself, the other occupants of the lab are likely to yell for mercy.

Occasionally, the local medico may be able to recover a few odd decibels by dewaxing the outer ear but, in general, what is gone is gone and there is precious little one can do about it.

In most cases, the loss is progressive and gradual and is largely unnoticed in the ordinary pattern of living. Virtually all the melody and all the fundamental tones of music are in the frequency range below about 5kHz, so that impairment of the upper frequency response does not prevent a person being involved with music in the ordinary way.

They may or may not notice that instruments seem to sound a little more "mellow" than once they did.

People most likely to be aware of a hearing limitation are the high fidelity enthusiasts who, in one way or another, gain access to an audio generator. They feed its output into an amplifier and loudspeaker, run up the range and promptly start worrying about something that, previously, they were hardly aware of!

Our correspondent asks whether there is anything he can do about it.

Frankly, I'm not very optimistic.

Without having researched the position, I have the broad impression that our sense of hearing exhibits a fairly sharp cut-off. Acuity may diminish gradually as the frequency goes up but there seems to be a region where it cuts off quite sharply. Many times I have seen people give answers "yes I do hear it" or "no I don't", when rocking the audio generator dial through a couple of kHz.

Regarded as a low-pass filter, this is a very sharp cut-off indeed — far sharper than one would normally encounter in an electrical crossover network. It would be quite difficult to doctor the output of a reproducing system to produce the inverse of such a curve, even assuming that it would be worth attempting.

But what about likely imbalance between a person's two ears? And what about other people in the room, who may well be exposed to what would be, to them, a sharp peak in the treble response?

Specially doctored headphones or headphone circuits might overcome some of the problems of imbalance and annoyance to others but not everyone would be prepared to forego the natural spaciousness of loudspeaker listening for headphones.

The most practical approach may well be to take what advantage one can of the treble boost facility in the amplifier system, consistent with what other people in the home will tolerate. It will brighten up that part of the spectrum where useful response remains but it won't do much to help above the cut-off frequency.

However, I wouldn't want this to be a final word on the subject. Our correspondent has highlighted a very real problem about which few will need convicing. Among our readership there may be those who have looked closely at it, with a view to evolving a practical answer.

On the other matter raised by F.B. there are various reasons for suggesting the use of absorbent filling in loudspeaker enclosures. However, they do not add up to a case for always using filling.

One approach to the design of compact loudspeaker systems is to mount a small, high compliance driver (typically of 6in or 8in diameter) in a sealed enclosure no larger than it strictly needs to be.

Such a system normally exhibits a bass resonance more prominent and at a higher frequency than that exhibited by the loudspeaker itself in free air. It may well be that the particular combination of loudspeaker and enclosure volume produces a bass resonance sufficiently prominent and sufficiently high in the range to give the bass an obvious "thumpy" sound.

Filling the enclosure with a light texture acoustic wadding will usually reduce both the amplitude and the frequency of resonance, and minimise its effect on the general balance of the reproduced sound.

Again, over the years, numerous vented loudspeaker systems have been constructed by enthusiasts, using a variety of loudspeakers and a variety of enclosure designs. In some cases, the bass has been prominent enough but quite lumpy, due to peaks and troughs in the response curve.

We have suggested that the lumpiness can often be smoothed out by partially filling or completely filling the enclosure with the lightest obtainable acoustic wadding.

A further possible advantage of filling is that it inhibits standing waves in the enclosure at middle frequencies related to the internal dimensions. Sound waves which are generated in the box and emerge though the port or loudspeaker opening have been described as "honking".

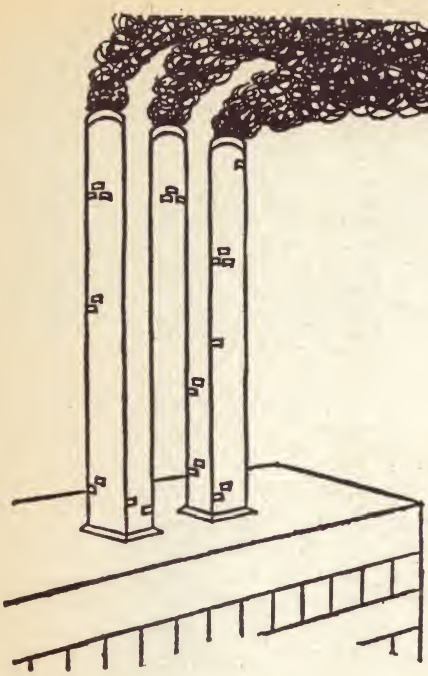
If an unfilled loudspeaker system does not exhibit a prominent bass resonance, or a lumpy bass characteristic, and if the internal faces are padded sufficiently to stop mid-range reflections, there is no point whatever in filling the interior with acoustic wadding.

On the other hand, a designer committed to a certain loudspeaker and a certain enclosure size may elect to use acoustic filling as a deliberate part of the design. In such a case it would almost certainly be wrong to take it out.

In general terms, the use of acoustic filling will tend to reduce loudness, particularly at the bass end. Therefore, judged on the basis of the amount of noise a system can make at low frequencies, filling would always be rejected. However, if the filling produces a smoothly tapering bass response, and if this tapering response can be compensated easily with bass boost from the amplifier, the end result may be much more pleasant and natural.

So much for audio / hifi.

If you're in the mood for a chuckle have a look at the letters and the illustration at the top of the next page. The best chuckle, however, came in a quite unexpected way when the letter from J. I. came to the notice to a visitor to our office who does not have the advantage of having been born in Australia!



THOSE SUPPORT BRACKETS

Dear Sir,

The article on page 71 of the April issue relating to the Trichotometric Indicator Support Bracket was of considerable interest, as for some time problems have been experienced with the Trichotometric Indicator supports fitted to machines used in the manufacture and packaging of adjustable set-spanners, striped paint and prefabricated sparks suitable for automotive ignition systems.

By making up the bracket in accordance with the detail the problems have now been overcome, and I am now able to commence production of ambihelical hex nuts of the type used to secure the support.

J. I. (Upper Ferntree Gully, Vic).

Dear Sir,

In your April issue you showed a diagram of a Trichotometric Support Bracket, locked in place with a special Ambihelical Hex nut. By sheer coincidence a recent cartoon in the Sydney "Sun" contained a sketch of the factory in which both these items are made.

G.W. (Jannali, NSW).

He chortled at the contents and then laughed uproariously at the very appropriate "fake" address. What a humourist J.I. must be.

We had to resort to the postcode book to convince him that there was, in fact, such a place as Upper Ferntree Gully!

Back to more serious matters, attention has been drawn from time to time to the fact that, superficially, the Australian Broadcast Listener's Licence confers on the listener only the right to listen to broadcast stations, and in particular to those on the medium-wave broadcast band.

There is a 50/50 chance that the receivers which he is able to buy without hint of restriction contain provision for receiving a whole array of signals spread over the high frequency bands. Very few of the HF transmitters carry Australian broadcast programs. The vast majority are overseas broadcasters, amateur stations, communication services and so on.

A Broadcast Listener's Licence does not specifically cover the right to listen on these or other frequencies. But, equally, no other licence exists which does. We are left in the rather odd position where, provided we hold a Broadcast Listener's Licence, we can enjoy a purely de facto right to listen to anything else which we may happen to tune in on a tuneable multi-band receiver.

The Wireless Telegraphy Act does, however, impose a now somewhat dated condition that we must not communicate to a third party, or otherwise take unfair advantage of any private message that we might intercept.

This leads naturally to a couple of very pertinent questions: (1) Why do people need to pay a licence merely to operate a receiver, as distinct from a fee to support a broadcasting system? (2) If messages are private or confidential why are they transmitted in a form that can be understood by a casual listener?

It is interesting to note that we are not alone in this dilemma. It is relevant to quote from the editorial in the January issue of our associated English Journal "Wireless World". In spirit, it could have been written in Australia for Australia:

". . . Now, except for a 'collecting fee' claimed by the Post Office, and expenses incurred in the investigation of interference, the whole of the income from the 16 million television licences goes to the BBC. It is, therefore, no longer a licence fee but a program charge.

"Readers may well ask why we should now be getting steamed up about something which has been going on for a very long time. Quite unwittingly we have, apparently, been inciting readers to break the law. Little did we think when we published the recent articles on the reception of weather maps from satellites that a special receiving licence would be required by those who made and operated the equipment described.

"We are told by the Ministry of Posts and Telecommunications, although we have so far not received this in writing, that it is illegal to receive transmissions from a satellite. Apparently, a television licence — the only receiving licence now generally available to the public — permits, as did the sound licence, reception of "authorised broadcasting stations . . . and licensed amateur stations" and a satellite is not, we are told, a broadcasting station!

"A similar situation exists, of course, regarding the reception of aircraft VHF transmissions and those in the marine radio band. For although receivers covering these bands are available to the public it is illegal to use them.

"As a journal, we have always maintained the need for law and order in the transmission and reception of 'electromagnetic waves' although from time to time we have been critical of the administration . . . Could we not have one receiving licence covering all types of transmission?"

BOOKS & LITERATURE

Network theory

ASPECTS OF NETWORK AND SYSTEM THEORY, edited by R. E. Kalman and N. DeClaris Published by Holt, Rinehart and Winston, Inc, San Francisco, 1971. Hard covers, 235mm x 155mm (6in x 9¼in), 648pp. Price in Australia $19.95.

Despite its unlikely title, this book is really a memorial. It is a collection of papers dedicated to the memory of Professor E. A. Guillemin, professor of electrical engineering at Massachusetts Institute of Technology from 1944 to 1963, and author of classic texts in circuit and network theory. Professor Guillemin died on April 6, 1970 at the age of 72. He had written some seven textbooks and 37 papers, and could claim a long list of inventions — including the "Guillemin line" developed during the second world war for the generation of radar pulses.

The papers which form the book are all quite deep, and are intended mainly for engineers, research workers and academics. They are divided into five main sections, headed: 1 — Analysis; 2 — Synthesis; 3 — Generalisations; 4 — Applications; 5 — Pedagogical. There are 28 papers in all. The book begins with a memorial to Professor Guillemin, and ends with author and subject indices.

The review copy came from Holt, Rinehart and Winston (Aust.) Pty Ltd. Copies should be available at all major bookstores. (J.R.)

Electrical experiments

NOVEL EXPERIMENTS WITH ELECTRICITY, by John Potter Shields. Published by W. Foulsham & Co Ltd, Slough, Bucks, England, 1971. Hard covers, 5½in x 8¾in (140mm x 220mm), 96pp, many diagrams. Price in Australia, $4.25.

The aim of this book is to help the reader learn the basic facts about electricity and magnetism without the aid of complex and expensive apparatus. It includes experiments which range from a simple electroscope to a synchronous motor, from simple magnets to a model spark coil. Many of the parts should be available from a junk box; other parts should be readily available through electronic supply stores.

There are only four chapters: Basics of Electricity and Magnetism; Basic Experiments in Electricity; Experiments with Magnetism; Miscellaneous Electrical Experiments. In addition there is a chapter for the English reader explaining the differences between conditions in the USA (where the book was written) and in the UK. The chapter points out that the difference between the US mains and the British mains supplies is such that many of the experiments are dangerous and should be carried out only under adequate supervision. A similar comment would apply for Australia.

The book provides an interesting selection of experiments which should be of assistance to any beginner, provided that adequate safety precautions are taken when working with live mains. Even with that proviso, however, some of the experiments would be best omitted where the higher mains supply voltage makes them excessively dangerous.

The review copy was supplied by Grenville Publishing Co Pty Ltd, 401 Pitt Street, Sydney. Copies should be available from most larger booksellers. (J.H.)

Test instruments

RADIO, TELEVISION AND AUDIO TEST INSTRUMENTS, 2nd Edition, by Gordon J. King. Published by Newnes-Butterworths, London, 1972. Hard covers, 160 x 255mm, 199pp, many illustrations. Price in Australia $12.70.

The second and revised edition of another book originally written for Odhams Press by well-known British technical author Gordon King. It is a companion volume to his other books on servicing, such as "Television Servicing Handbook" and "Colour Television Servicing", which were reviewed recently in these columns. In fact it supplies some of the information on practical servicing and the actual use of instruments that I would have liked to have seen in these volumes.

The present book is a basic introduction to the measuring instruments used in servicing, as the title suggests. The contents and their order of presentation are shown fairly clearly by the chapter headings: 1— An Introduction to Instruments; 2— Application of DC Meters; 3— Application of AC Meters; 4— Electronic Meters; 5— Signal Generators; 6— The Oscilloscope; 7— Some Applications of the Oscilloscope; 8— Valve, Picture Tube and Transistor Testing; 9— Miscellaneous Instruments; 10— Instruments for Colour Television; 11— Instruments for Audio.

To me the book seems to be clearly written, and well presented — although there are one or two annoying publishing errors such as the transposition of a block in chapter 4 with another in chapter 11 (Figs 4.6 and 11.6). It should be found of considerable value by service technicians and trainees, students and enthusiasts.

The review copy came from Butterworth and Co (Aust) Ltd, who advise that copies should be obtainable at all major bookstores. (J.R.)

LITERATURE — in brief

FAIRCHILD AUSTRALIA PTY LTD, PO Box 151, Croydon, Vic 3136, has published a comprehensive data sheet for Fairchild zener diodes, covering the series AN753-759 and AN962-973. Utilising the planar process, these silicon diodes feature a voltage range from 6.2 to 33V, ultra-stable reverse voltage, low leakage, low dynamic impedance, and high reliability.

HEWLETT-PACKARD JOURNAL, Vol 23, No 5, January, 1972. Published by the Hewlett-Packard Co, USA. Contents: A computer-aided hospital system for cardiac catheterisation procedures; Clip-and-read comparator finds IC failures; The well-modulated synthesiser. Inquiries to Hewlett-Packard Aust Pty Ltd, 22-26 Weir Street, Glen Iris, Vic 3146.

PLESSEY DUCON PTY LTD, PO Box 2, Villawood, NSW 2163, has published a four-page product data sheet, PD 2076, which gives detailed technical information concerning an E-cell marketed by the company's Professional Components Department. The E-cell is a reversible electronic integrator with non-volatile memory for timing, integrating and counting. A brief description of the device is accompanied by diagrams showing its construction, its equivalent circuit, and a typical operating curve. Full characteristics of the device are presented numerically and graphically.

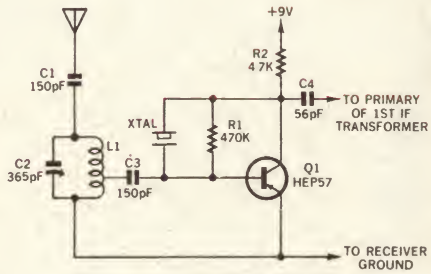
CIRCUIT & DESIGN IDEAS

Interesting circuit ideas and design notes selected by the Editor from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Contributions to this section are always welcome.

A Simple Short Wave Converter

Opposed to the trend towards more complexity in circuits, the simple converter shown here may be used with a portable transistor radio to pick up short wave signals. The radio set provides the IF and audio amplifiers and any crystal which is either 455KHz higher or lower than the wanted frequency should be suitable.

In operation, the signals are picked up by the aerial and coupled to the tuned circuit L1-C2. The inductor consists of 13 turns of 22B&S enamel wire wound on a ¼in diameter, 1-3/16in long ferrite core and tapped 4 turns up from the ground end. Capacitor C3 connects to L1 at the best point for impedance matching. The signal is



amplified by Q1 and mixed with the frequency generated by the crystal to produce an IF which is either the sum or difference of the two. This is passed on to the receiver IF input.

Any one of several types of transistors may be used for Q1, provided it is of the high frequency type.

To use the converter, hook up an outdoor aerial about 20 feet long. Turn on the power and start with C2 fully meshed. Slowly decrease C2 until short wave signals are heard. As the frequency of the crystal is reached, the converter will go dead and then come on again as the frequency is passed. The crystal will beat with signals first on the low side and then as C2 is tuned further, signals on the high side will be heard.

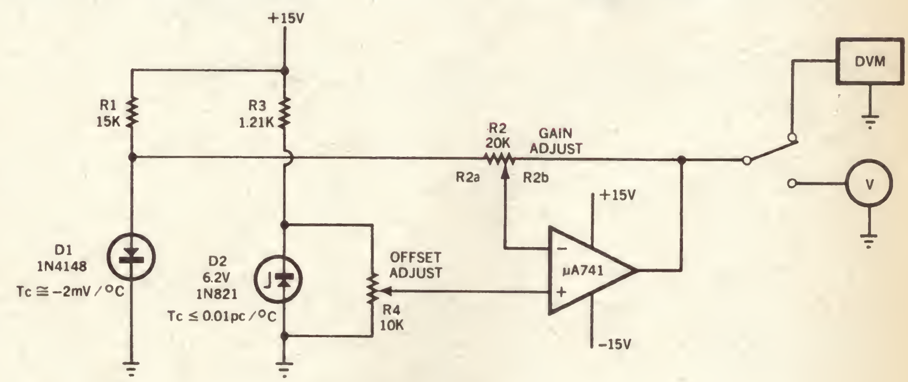
(By Larry Lisle, in "Popular Electronics".)

Diode Probe Electronic Thermometer

A silicon diode probe and an operational amplifier with an unusual gain adjustment are the key elements in an electronic thermometer that gives a readout, in degrees, on an ordinary voltmeter. The sensing circuit's voltage variations can be adjusted to align with a temperature scale. For instance, a 10- or 100- millivolt reading can represent 1°C at one setting or 1°F at another setting of the amplifier.

The operational amplifier is connected as a differential amplifier. An input that varies with the temperature of probe D1 is obtained through resistor R1 and part of R2. Zener diode D2 and R3 provide a reference voltage; offset is adjusted by R4. R2 is the gain adjustment, but it is not entirely within the feedback path as shown on the diagram of the conventional differential amplifier. In the location used, R2 helps to make the output both linear and scalable.

After potentiometer R2 in the actual circuit is adjusted to bring the output within a suitable range on the voltmeter, potentiometer R4 is used to adjust offset. This aligns V out with the desired temperature



scale so that the reading corresponds to degrees without further conversion. The instrument is calibrated by setting R4 with the probe at a known temperature.

Metal film resistors, wire wound potentiometers, and the small temperature coefficient of the temperature compensated zener diode give the circuit excellent temperature stability. Minor variations in supply voltage do not significantly affect accuracy. Since the dynamic impedances of the two silicon diodes are matched closely, supply voltage changes result in a common-mode input signal that is greatly attenuated by the amplifier.

(By Robert J. Battes, in "Electronics".)

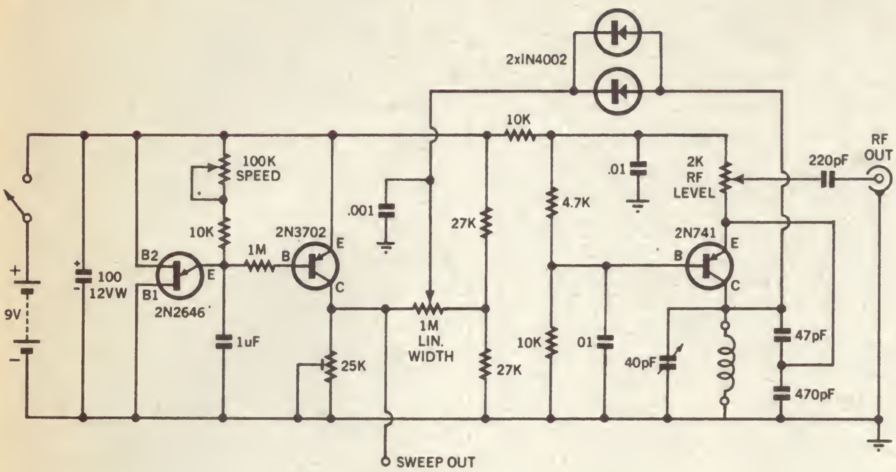
Silicon Diode Sweep Generator

This simple RF sweep generator has proved invaluable for aligning IF and RF circuits over a wide range of frequencies. The circuit consists of a Colpitts oscillator which is swept by means of two varactor diodes. The diodes are direct coupled from a unijunction sawtooth oscillator, via a common emitter stage. The sawtooth is also used for the CRO horizontal sweep.

The RF oscillator uses plug-in coils enabling any desired centre frequency to be selected. The greatest frequency sweep will occur when the capacitance of the tuned circuit is kept to a minimum, which means that a typical 455KHz IF coil needs extra turns added for best results. A 50KHz sweep has been obtained at 455KHz and the circuit has been tested up to 10.8MHz.

To prevent the diodes from conducting at any point of the RF cycle when maximum sweep width is used, the oscillator level is kept low by means of the 10K dropping resistor. Correct operation may be checked by displaying the RF output on a CRO. If the level drops at the low frequency end of the sweep, the 10K resistor should be increased. However, the stage may fail to oscillate if the voltage is reduced too much. Any germanium PNP RF transistor should be satisfactory for the RF oscillator.

The unijunction oscillator and the following stage are so arranged to produce a sawtooth waveform with some curvature.



This tends to counteract the non-linear capacitance voltage characteristic of the diodes.

The 25K trimpot should be set so that the stage just bottoms (saturates) at the beginning of the sweep. If saturation cannot be obtained with the trimpot set to maximum, reduce the value of the 1M base feed resistor.

The sweep width control is very useful when checking amplifiers using narrow band ceramic, crystal, mechanical or LC filters. Under these conditions, only a few sweeps per second are used to prevent ringing effects. Also, the display may be expanded to show a very small part of the spectrum in detail.

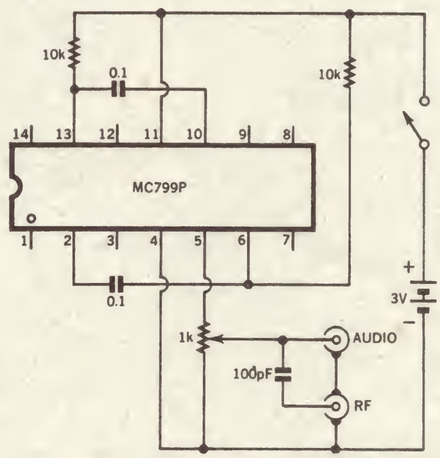
The original unit was assembled on a 3in strip of tag board and mounted with the battery, controls and sockets in a 4in x 4in x 2in box. Several suitable coils with tuning slugs were salvaged from an old all-band receiver.

(By Mr P. H. Mathieson. M.I.E. Aust., Box 67, Ukarumpa. E.H.D., PNG.)

Signal Injector Uses IC

After reading about "A Useful Signal Injector" in Circuit & Design Ideas for February, 1972, I found that the transistor type AS28 was difficult to obtain. As a result, I decided to make up an injector using a Motorola IC type MC799/P and the circuit shows what I came up with. It is basically a battery powered 1000Hz multivibrator that generates square waves. The amplitude of the square wave output is fully variable and sufficient to test a loudspeaker.

The injector also provides a wide bandwidth RF signal suitable for testing RF and IF stages. Current drain is of the order of 80mA which allows of a reasonably long battery life. The resistors used were ¼W types and the 1K potentiometer is a carbon type, with switch. The two 0.1uF capacitors are 10V disc type, the 100pF capacitor is also a disc type.



Construction may be left to the individual ideas and requirements of the builder. Many ideas will no doubt suggest themselves, possibly dictated by what materials and facilities happen to be available at the time.

(By Mr N. Hodgson, 3 John Street, Frankston, Victoria 3199.)

Applications for Relay Reeds

Bert Allen, G2UJ, points out that there is a simple way of adding contacts to existing relays. This is done by employing the existing energising coil to operate one or more reed switches, in addition to the normal spring set.

All that is necessary is to fix one or more of these reed switches on the outside of the relay coil, parallel to the coil. They can be fixed in position using adhesive tape.

G2UJ gives as an example that a 100 ohm relay coil operating at 6V will actuate as many reed switches as can be placed around the outside of the centre of the coil, other than close to the framework. And all this, it should be noted, without interfering in any way with the normal operation of the relay.

There may also be some readers who do not realise that these little reed switches can readily be actuated by the physical movement of a small magnet. This approach has in the past been used in such applications as burglar alarms, for interlock systems, etc. The only difficulty with some of these applications is that if a reed is held closed over a very long period there is always some slight danger that a cold weld may cause the contacts to stick and remain closed.

On this general subject of using reed contacts, Peter Chadwick, G3RZP, draws attention to the important limitation when used for switching RF due to skin-resistance effects. He considers that when used, for example, in aerial change-over applications the real limitation is in the power handling. His own experiences suggest that about 1.7A of two-tone SSB represents the practical limit, although on speech transmission it may be possible to push the level a little higher. It is important to appreciate that this limit stems from the effect of skin resistance — a point which we underlined back in 1966 following discussions in Stuttgart with Heinz Rensch, the reed relay expert of SEL.

Even with heavy gold plating, G3RZP finds the reed can get so hot that the material either passes its Curie temperature or the glass distorts.

(From "Radio Communication".)

Work of art 6EA8

Craftsmanship in metal and glass. The AWV 6EA8 oscillator/mixer valve: eyes and ears of the television receiver.

A work of electronic artistry created to pluck a television signal out of the air, designed to receive both audio and video signals, and constructed with the technical perfection of all true works of art.

An example of the special beauty that AWV sees in both the function and design of electronics.

An object no less beautiful because of its everyday application.

For AWV, electronics is a living art.

Amalgamated Wireless Valve Co. Pty. Ltd., your experts in the art of electronics.

Power Supplies

Valve equipment power supplies — problems in using AC to heat valves — the indirectly heated valve — the full-wave rectifier, using valve diodes — smoothing and filtering with inductance and capacitance — the use of semiconductor diodes — the voltage-doubler rectifier — the half-wave rectifier — transistor equipment power supplies — the bridge rectifier — dynamic filtering and regulation.

For the sake of simplicity, most of our circuit discussion to date has assumed the provision of suitable DC supply voltages, without much emphasis on how such voltages are obtained. In this chapter, we explain how supply voltages are derived from the AC power mains.

In the early days of radio, receivers were invariably supplied from batteries. It was commonplace to use either an accumulator for the filament supply or a number of heavy-duty dry cells capable of supplying the requisite and often considerable filament current.

The grid bias voltages were taken from a special bias battery, not intended to deliver significant current, but with tappings at each cell junction to give voltages in 1½-volt steps to 4½ volts or 9 volts — to quote what were common figures

For the plate supply, so-called radio "B-batteries" were used. These were large and rather expensive banks of dry cells, usually made up in 45-volt blocks and tapped at 22½ volts. Two such B-batteries in series could supply 90 volts, while three in series were commonly employed to give 135 volts. How cumbersome and expensive these batteries were tends to be forgotten in these days of transistor receivers.

While the early sets were simple enough from the designers' point of view, the need to provide, attach, and conserve batteries was a constant worry to radio set users and it was natural that efforts should be made to cut the operating costs, at least. As a result, various gadgets appeared aimed at supplementing or replacing the expensive batteries.

Numerous chargers or "trickle chargers" were put on the market for recharging the filament accumulators. The chargers might deliver currents up to 3-odd amperes and would top up a discharged battery in a day or so. Trickle chargers were designed to be left on more or less continuously, keeping the battery full at all times and saving the hitherto regular trip to the local garage for a battery re-charge.

So-called "B-Battery Eliminators" were released, to replace the high-tension batteries altogether. These incorporated a transformer, rectifier and filter system, rather like a modern AC power supply. Various resistors and tapping points were included so that they could supply the requisite intermediate voltages at the order of current drain commonly encountered in battery sets of the day.

Some B-battery eliminators also included auxiliary circuits to provide negative bias voltages, although the cost of a bias battery was never a major item.

These various units enjoyed a limited degree of popularity, but the obvious objection of having gadgets and accumulators attached to the family radio provided strong incentive to produce self-contained receivers which could simply be plugged into the power point and operated therefrom just like any other electrical appliance.

Initially, the main difficulty was that of providing filament supply. For reasons we shall see a little later, AC from the power mains could not readily be changed to DC at the voltage and current needed to operate a number of parallel-connected filaments. And there were — and still are — two basic objections to applying AC to the filament of a directly-heated valve.

The first and perhaps most obvious objection is that because the filament has a certain voltage drop, the effective bias between filament and grid varies over its length. As a result if the filament is heated by the application of AC, an alternating voltage component tends to be superimposed upon the desired DC bias to modulate the plate current and cause hum. It is possible to cancel out most of this superimposed component by accurately centre-tapping the filament AC supply, and this was done with early receivers designed to be operated directly from the mains. But unfortunately this technique does not avoid the second problem.

Because alternating current falls to zero twice in every cycle, the temperature of the filament tends to vary cyclically when AC is used to heat it. This causes a corresponding variation in the number of electrons produced, and thus still tends to modulate the plate current to produce an undesirable hum (in this case at twice the AC supply frequency). In an attempt to overcome this problem the directly heated valves used in early AC receivers had special low-voltage high-current filaments made from thick wire and therefore thermally sluggish. However this was only partly successful.

A satisfactory solution to the problem only came with the introduction of valves having "indirectly heated" cathodes. Such valves were described in an earlier chapter.

With the development and release of valves having indirectly heated cathodes the major problem with all-mains operation disappeared and numerous receivers were released using them. It was still necessary to produce from the mains a pure DC supply for the valve plates and screens, but, as we shall see, this was not — and is not — a major problem.

In most radio receivers, amplifiers and other equipment using valves, the DC supply for the plates and screens is provided by a power supply circuit using a transformer and rectifier. In early equipment the rectifier used was a valve, usually a double diode. In more modern equipment silicon diodes are used.

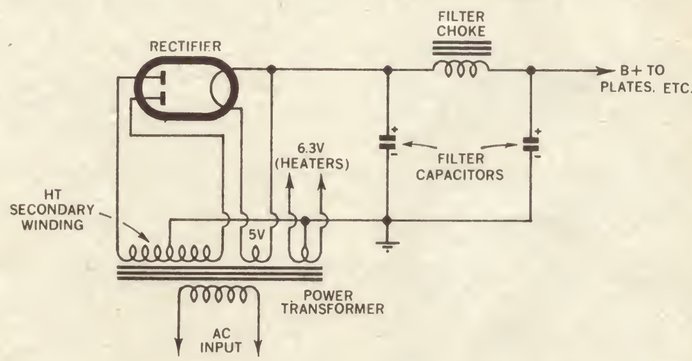


Figure 1: A typical power supply circuit using a valve rectifier as used in older receivers and amplifiers. Supplies using semiconductor rectifiers are more common in modern receivers.

Figure 1 shows a typical valve rectifier power supply circuit, whose operation we can proceed to discuss.

The heart of the supply is the power transformer, which is shown diagramatically as a number of windings adjacent to an iron core. The transformer is used to provide low voltage AC for the valve heaters as well as the plate supply.

The incoming power lead is connected across the primary winding, which will normally be rated to receive an input of 240 volts AC. It must be AC. A power transformer must not be connected across DC mains. If it is, it is almost certain to blow the fuses or burn itself up, or do both!

The reason for this is not hard to discover in that a transformer relies for its operation on a constantly changing magnetic field. As the alternating current from the power mains flows to and fro through the primary winding, it causes a strong magnetic field in the iron core to build up and collapse in cyclic fashion. The moving lines of force thus created induce current and voltage in the various secondary windings, obeying the laws of magnetism explained in an earlier chapter.

The alternating voltage developed across each secondary winding is almost exactly proportional to the ratio of turns between the primary and the secondary winding in question. Thus, if there are 1,200 turns on the primary winding, a secondary winding also having 1,200 turns would deliver the same 240 volts as fed into the primary — because the turns ratio would be 1:1 On the other hand, if a 6.3 volt winding is required to operate a number of valves with 6.3 volt heaters, then this heater winding would need to have 1,200 times 6.3 / 240, or approximately 32 turns.

In the above illustration we suggested 1,200 turns for a 240-volt winding on the assumption that the transformer might be wound on the basis of five turns for every volt of input or output. This is a likely enough figure, but, in practical transformers, the turns-per-volt figure may vary considerably from one type to another, according to the size of the core, the grade of the iron used and the ideas of the designer.

The thickness of the wire used on each winding depends on the current which it has to handle or deliver. In the case of a heater winding, which may be required to deliver several amperes, relatively thick wire has to be used and it is commonplace to see heater windings using 16-gauge enamelled wire or thicker.

It is important to realise that the gauge of wire used in a transformer winding determines only the amount of load current it can handle, without over-heating, if required to do so. Thus a winding rated to deliver, say, three amperes, can deliver up to three amperes without tending to overheat, according to the number of valves which may be connected to it. If only one valve were connected to the particular winding, the current drawn from it would probably be less than one amp.

Typical low power transformers designed for use in the power supply of a radio set, television receiver or similar equipment may have one, two or even three heater windings, to give the voltages and currents likely to be required. If designed in recent years for valve equipment, most heater windings are likely to be designed to produce a voltage of 6.3 volts RMS, to suit most modern valves.

In the circuit of figure 1 we have shown two heater (or filament) windings, one to supply the rectifier and the other to supply the heaters of all other valves in the receiver. The latter is shown as having a centre-tap connection, earthed to the chassis.

Heater wiring is usually earthed for two reasons:

Firstly, the heater winding is very close, inside the transformer, to other windings producing high alternating voltages. Because there is some capacitance between them, some of the high voltage energy can be coupled capacitively to the heater winding and to the wiring connected to it.

A typical transistorised regulated power supply suitable for use with experimental circuits. It provides an adjustable output voltage from 0 to 30V at a maximum current of 1A. The meters are included to indicate the output current and voltage.

This doesn't interfere in any way with the basic operation of the heater circuit but the high ripple voltage present on the heater wiring throughout the chassis can couple into grid circuits and produce an objectionable hum or buzz in the output.

A second reason is that wiring running from one stage to another thoughout a high-gain receiver can transfer signals by stray coupling and produce troublesome regeneration.

Earthing the heater wiring largely obviates both effects. Although we have shown a centre-tap earth return, this is not strictly necessary except, perhaps, in equipment having very high audio gain. In many cases it is sufficient to earth one side only of the heater wiring.

For the plates and screens, AC from the power mains must be rectified and filtered till it becomes virtually pure DC. This involves, normally, a high tension secondary winding on the power transformer, a rectifier, a filter choke and two or more filter capacitors.

As might be expected, the high tension winding involves many turns of fairly fine wire, so that a considerable voltage is developed between its outer ends. Since the voltage across it is alternating, each end swings alternately positive and negative with respect to the other.

In valve rectifier circuits such as that shown, the high tension secondary winding has a centre-tap which is returned to chassis (shown as earth) so that half the total secondary voltage appears between earth and the respective ends. When one end of the winding swings positive with respect to earth the other end simultaneously swings negative by an equal amount.

As with the heater windings, the rating of

How do you order electronic equipment housing at less cost? Or create your own exclusive console designs without tooling costs?

IMPORTANT ANNOUNCEMENT
From May 1st we open our own office in Victoria

Simply call an 'IBI'* man!

imhof-bedco

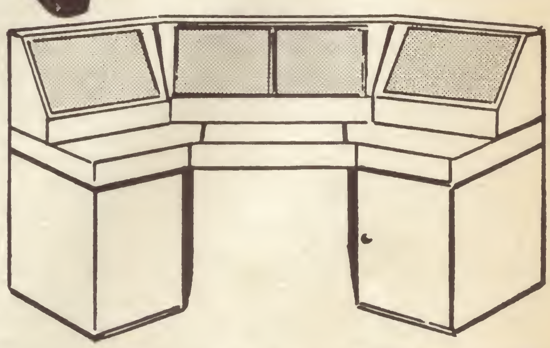
**that's IMHOF BEDCO-IMLOK*

He's got the facts, figures and answers to your every housing question. With catalogues, instruction booklets and experience in designing and producing electronic equipment cases, racks, consoles and prototypes. Ask to see the wide range of attractively finished panels and discover the production economies possible from limitless variations of corner connectors and extrusions.

Want to build an inexpensive prototype? Your IMHOF-BEDCO-IMLOK man will show you how to build it cheaply with the finished appearance of a production model. No elaborate tools are needed.

You can have IMHOF-BEDCO-IMLOK equipment custom built and mass assembled to your exact specifications. Or you can produce the finished product yourself. With a complete stock of accessories available such as hinges, slides, catches, handles, rubber feet, screws, nuts and washers.

Speed, ease and production economy, that's IMHOF-BEDCO-IMLOK equipment. And it all starts with a call to your "IBI" man.



a division of **Aladdin** Industries Pty. Ltd.

43 Bridge Road, Stanmore, N.S.W. 2048. Phone: 51-2826
13 Cottage Street, Blackburn, Victoria 3130. Phone: 878-3433
All States coverage
QLD.: Plastic Products Pty. Ltd., Curtin Ave., Hamilton Central, Brisbane 4007. Phone: 68-1121
S.A.: Warburton Franki Pty. Ltd., 322 Grange Rd., Kidman Park. 56-7633
W.A.: Warburton Franki (Perth), 173 Hay St., East Perth 6000. 25-7787

ALO28/FP

the high tension secondary, in terms of voltage and current, varies with the size of transformer and the receiver which it is to supply. A small transformer, to supply a small mantel radio receiver, might typically have a HT secondary rating of 150 volts either side of the centre tapping, at a nominal current rating of 30 milliamps — this figure referring to the permissible DC load current.

A large transformer, intended to supply a television receiver, or amplifier, might have a voltage rating per side of up to 400 and a nominal DC load current of up to 250 or even 300 milliamps.

The two ends of the HT secondary winding are connected to the two plates of the rectifier valve, as depicted. This valve is virtually two diode elements in the one envelope, the plate and filament structure being expressly designed to carry a considerable amount of current.

A valve of this type, intended for use in a power supply and having two separate anodes or plates, was commonly referred to as a full-wave rectifier.

The filament of the rectifier is fed from a separate winding on the transformer, which is typically rated to deliver five volts at two or three amperes. It is quite usual for rectifier valves to consume considerable heater or filament power, the cathode or filament being designed to provide copious electron emission and thus allow the valve to pass heavy current without danger of early failure in service.

To follow the action of the rectifier, consider the instant when a positive voltage has appeared on the left-hand half of the HT secondary and therefore on the upper rectifier plate, as drawn.

Since the plate is positive, electrons will tend to flow to it from the heated filament. We can consider the result in a couple of ways, both of which lead to the same conclusion:

(1) In losing electrons, which are essentially negative charges, the filament of the rectifier must itself become positive.

(2) When conduction takes place through the rectifier, the impedance of the filament-to-plate path in the valve must decrease. The filament must, therefore, approach the plate potential, and, since this is temporarily positive, the filament must tend also to become positive.

Whichever way one cares to look at it, the result is the same — a positive potential on the plate and conduction through the valve produces a positive voltage at the filament.

When the same plate swings negative, during the next half-cycle, there is no conduction through the valve and, therefore, no tendency for the filament to develop a simultaneous negative potential.

On the contrary, as the first plate swings negative, the second plate simultaneously becomes positive and conduction takes place between the filament and this second plate. Once again, therefore, the filament tends to be carried positive.

In other words, during successive half cycles, when each plate in turn swings positive, current flow through on half of the rectifier or the other tends to carry the filament positive also. Since there are 100 half cycles per second with 50Hz power mains, 100 positive pulses are apparent at the rectifier filament per second.

The 50Hz alternating voltage at the rectifier plates is thus changed to pulsating DC at the rectifier filament, positive with respect to chassis and having a heavy ripple content of 100Hz.

This positive voltage is generated at the rectifier filament quite independently of the five-volts AC coming from the transformer winding to heat the filament. This latter voltage, applied across the rectifier filiament, raises it to operating temperature. When the positive voltage is generated, it carries the filament as well as the transformer winding feeding it, to a high positive potential in respect to chassis.

Obviously enough, since the rectifier filament winding is expected to be at a positive potential with respect to chassis, it must not be earthed.

Instead a wire connected to one wire of the filament or its supply winding becomes the source of the positive potential which

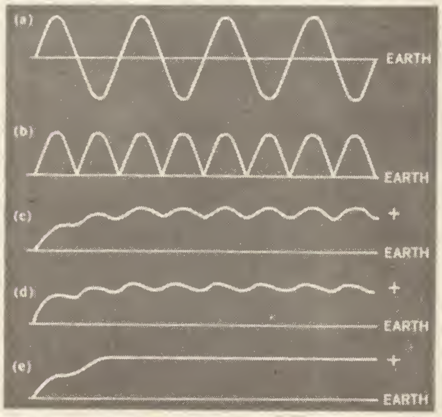


Figure 2: Voltage waveforms associated with rectification and filtering in a simple power supply. Filtering is necessary to produce smooth DC from the pulsating rectifier output. The waveforms shown are: (a) the transformer secondary voltage, (b) the rectifier output, (c) the effect of the choke, (d) the effect of the capacitor, and (e) the output DC.

must ultimately be fed to the plates and screens of the remaining valves in the equipment.

However, the plates and screens must be fed with substantially pure DC, not a voltage which has a very high ripple content. To get rid of the ripple, it is necessary to use what is known as a filter system, which as shown in figure 1 may involve a filter choke or inductor and a number of filter capacitors.

The inductor consists normally of a large number of turns of wire wound within a laminated iron core, much like that used for small power or output transformers. It must be capable of carrying the amount of current involved in the particular supply and, with this current flowing, must have an inductance usually of several Henries.

In some older-type radio receivers a filter choke, as such, was not used. Instead the current from the pwer supply was passed through a winding around the pole piece of the dynamic speaker. This gave the requisite inductive effect for filtering, and the magnetic field created by the current served at the same time to energise the speaker's magnet system. The so-called "field" winding on the loud-speaker therefore served a double purpose.

It may be remembered that in an earlier chapter we learned that an inductor tends to resist any change in the amount of current flowing through it. If the current increases above average, part of the energy involved is diverted into creating a stronger magnetic field around the winding. If the current decreases, the magnetic field is reduced and returns some of its energy to the winding as current flow.

As a result of this action, current flowing through a filter choke loses a good deal of its ripple content and becomes more nearly pure DC. This is illustrated in figure 2, where (a) represents the transformer secondary AC voltage, (b) the basic rectifier output, and (c) the effect of the inductor.

As indicated earlier, capacitance is also involved in a filter system, its effect being more or less complementary to that of inductance. A capacitor tends to oppose any change in the potential or voltage across it. If the voltage rises above an average value, some of the energy involved is diverted into the capacitor as an extra charge. If the voltage then subsequently falls, the charge is released, tending to maintain the original potential.

When one or more capacitors is connected between the B-plus supply line and earth, as in figure 1, they naturally tend to oppose or absorb the change in potential due to ripple from the rectifier. They charge on "peaks" and release energy subsequently to fill the "troughs." Diagrammatically, the effect is as illustrated in figure 2d.

If properly designed, the combined effect of the choke and capacitors is to completely eliminate the ripple content for all practical purposes, and the output from the supply becomes virtually pure DC. (see figure 2e.)

The rectifier circuit of figure 1 is known as a condenser-input or capacitor-input filter, because the rectifier feeds directly into a capacitor. In the less common arrangement, where the rectifier feeds directly into an inductor, the filter is described as a choke input filter.

Filter capacitors normally need to have a large value of capacitance, certainly not less than eight microfarads each. To obtain this capacitance in small space and with adequate working voltage, not forgetting price either, they are invariably electrolytic types, as described in an earlier chapter.

The main point to remember about electrolytics is that they must be connected the right way round, with their positive terminal connected to the positive side of the circuit.

In recent years, much higher values of filter capacitance have become practical and, as a result, chokes having much lower inductances will suffice for the same degree of filtering. In point of fact, many small power supplies these days do not use a choke at all, relying only on large capacitors to give an adequate storage and filtering effect.

Readers may recall from the earlier chapter on semiconductors that a semiconductor diode behaves almost identically with a valve or thermionic diode. In view of this, it should not be very surprising to learn that semiconductor diodes can be used in rectifier circuits in place of diode valves.

In point of fact, they are somewhat better suited to this task than valves, as they require no heating power and also tend to conduct more easily during the part of the

cycle when they are called upon to do so. They also have a longer life, and are more reliable in service. At present, their only disadvantage is that they tend to be vulnerable to damage from transient over-voltage "spikes" which are at times present on AC mains.

Two semiconductor diodes can be used in a full-wave rectifier circuit similar to that shown using a valve in figure 1, the only difference being that the diodes do not require a filament wiring on the transformer. They are simply wired with their cathode connections tied together as the output connection leading to the filter circuit and the load circuit, and each anode connecting to one end of the transformer HT secondary winding.

This type of rectifier circuit is not often used where semiconductor diodes are employed, however, because it requires the diodes to have a high peak inverse voltage rating. The peak inverse voltage is the reverse-bias voltage which appears across each diode when it is "off" and the other is conducting.

With the full-wave rectifer circuit, the reverse-bias impressed upon the diodes when they are non-conducting is actually 2.828 times the half-secondary RMS alternating voltage, and this can require the use of costly diodes having a very high peak inverse voltage rating.

Because of this, it is often more desirable to employ what is called the full-wave voltage doubler rectifier circuit whenever moderate to high voltages and currents must be rectified by semiconductor diodes. Figure 3 shows a circuit of this type.

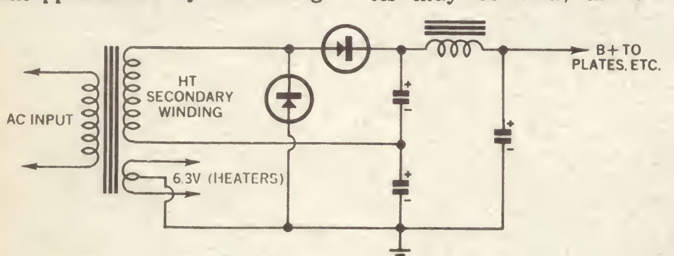


Figure 3: Most power supplies using semiconductor rectifiers use the full-wave voltage-doubling circuit as shown here. It suits the rectifiers better, and is more compact and economical.

A single untapped secondary HT winding is used on the power transformer, and the winding is arranged to produce an alternating voltage of only half (approx) the required DC output voltage. It should be noted, in passing, that this makes the power transformer somewhat simpler than in the full-wave circuit, and consequently somewhat less bulky and costly to produce.

Two semiconductor diodes are used as before, but this time they are connected in a different fashion. The first filter capacitor also undergoes a change, becoming two separate units which fill a more complex role than did the single unit of figure 1.

Neither end of the transformer HT secondary winding is earthed. Instead, one end goes to the junction of the two series-connected filter capacitors, while the other end goes to the two diodes. One diode has its cathode connecting to the winding and its anode earthed, while the other has its anode connecting to the winding and its cathode connecting to the top of the uppermost filter capacitor and the DC output circuit.

The operation is as follows: For the half-cycles when the top of the transformer winding is negative and the bottom positive, the "series" (upper) diode is reverse-biased and non-conductive. The "shunt" (lower) diode is forward-biased, however, being connected to the winding via the lower filter capacitor.

It therefore conducts, and in doing so it charges the lower capacitor to the peak value of the alternating voltage appearing across the winding. The capacitor voltage is as shown, with its earthed end negative with respect to the top end.

During the other half-cycle of the AC wave, when the top of the transformer winding is positive with respect to the bottom, the "shunt" diode is reverse-biased and non-conductive, while the "series" diode conducts. This time the upper capacitor is charged to the peak value of the AC secondary voltage, as it completes the circuit back to the lower end of the winding. The voltage across it has a polarity as shown.

As may be seen, the two capacitor voltages add together, and the total pulsating DC voltage available for filtering is twice the peak value of the transformer winding RMS voltage. Under load this voltage drops toward twice the RMS voltage.

The most important thing to realise about the voltage doubler circuit is that for a given and required DC output voltage, each diode has to deal with only half the voltage it would meet in a conventional full-wave circuit. Thus the doubler circuit allows the use of relatively inexpensive semiconductor diodes having but a moderate peak inverse voltage rating.

The voltage doubler circuit found almost universal acceptance in valve television receiver power supplies and in many other places where high current is required at a fairly high voltage. Silicon diodes are used almost universally in this circuit, as they are most easily arranged to have the required peak inverse voltage and forward conduction current ratings.

In power supplies where the voltage and current demands are very slight, it is possible to use a single diode valve or a single semiconductor diode in what is called a half-wave rectifier circuit. Such a circuit using a semi conductor diode is illustrated in figure 4.

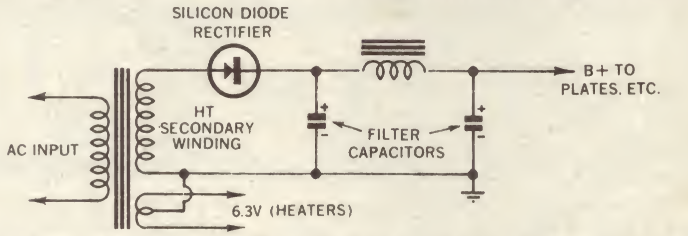


Figure 4: When only very low current drain is involved, a half-wave rectifier system may be employed. A valve rectifier could be substituted for the semiconductor in this circuit.

A single untapped transformer secondary winding is used as with the doubler, but this time it needs to provide an RMS voltage approximately equal to the required DC output voltage. One end of the winding is earthed and the other connects to the first filter capacitor via the diode.

The circuit is in effect half the full-wave circuit, and the diode only conducts on every alternate half-cycle when the top of the HT secondary is positive. The half-cycles when the winding voltage is reversed are not used.

The half-wave circuit is thus rather inefficient, as it only uses half the energy available from the transformer. It is as a result only suitable for low current rectification and, as the diode has to have a peak inverse voltage rating of approximately 2.828 times the DC output (which is approx. equal to the RMS voltage of the HT secondary) it is really only practical for low voltages as well.

The half-wave rectifier circuit delivers only one pulse of DC for each AC input cycle, so that its DC output ripple frequency is 50Hz. This makes filtering somewhat more difficult compared to the 100 Hz ripple produced by the full-wave and doubler circuits.

So far in this chapter, we have thought mainly in terms of power supplies required for the operation of valve receivers and equipment from the mains. Let us now look at the type of power supply required to operate transistor equipment from the mains.

As we saw in an earlier chapter, transistors are relatively low-voltage devices compared with valves. They typically operate with supply voltages of from 3 to about 80 volts, whereas valves normally use somewhat higher voltages.

Where transistor circuits are required to deliver appreciable amounts of power — for example, in the case of transistorised audio amplifiers — they must accordingly be supplied with higher currents than valve circuits of equivalent performance. This is simply because to deliver power, they must be supplied with power, and power is effectively the voltage multiplied by the current.

Figure 5 shows a fairly typical type of transistor power supply. The power transformer has only one secondary winding, an untapped low voltage winding. This is connected to a so-called bridge rectifier circuit, using four silicon diodes or a selenium "stack" (as used in battery

charger rectifiers), and thence to a very high value filter capacitor C1 and a further regulator and filter circuit using a transistor.

The bridge rectifier is full-wave, in that it operates on both half-cycles of the AC wave. It differs from the full-wave circuit of figure 1 in that it does not require a tapped supply winding, and it differs from the doubler in that it does not supply a DC output voltage twice that of the RMS input voltage.

In the bridge circuit, two diodes conduct during each half-cycle. When the top end of the transformer winding is positive, diodes D1 and D3 conduct, and when the lower end of the winding is positive diodes D2 and D4 conduct.

The peak reverse voltage across the formed by resistor R and capacitor C2, while the emitter becomes the output electrode and connects to the load transistors which must be supplied with power.

The simple resistor-capacitor filter circuit used to supply the base bias for the transistor is sufficient to provide adequate smoothing, because the base current required is relatively small. However the fact that the transistor is fed with well-smoothed base current means that its collector-emitter current — which is an amplified version of the base current — also tends to be well smoothed. Hence the relatively high current fed to the load transistors is smoothed, and the effective output voltage produced at the emitter of the filter transistor is also smoothed.

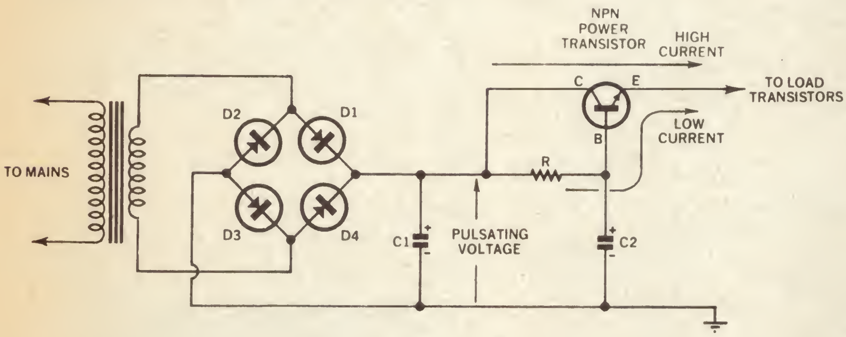


Figure 5: Fully transistorised equipment normally needs a much lower supply voltage than valves but at a much higher current. This typical transistor supply shows a bridge rectifier system, a high value filter capacitor, and a transistor dynamic filter circuit.

diodes when they are non-conductive is 1.414 times the RMS supply voltage and (approx) the DC output voltage, so that the bridge circuit is midway between the full-wave and doubler circuits in its demands upon the diodes regarding their peak inverse voltage rating.

The low-voltage, high current requirement of transistor power supplies makes filtering the AC ripple from the DC output a difficult task. A very large first filter capacitor is required (some supplies use 10,000 uF or higher), and as we have shown a transistor filter circuit must often be used for additional filtering. To maintain the output voltage constant under load it may also be necessary to add further circuitry for regulating the output.

The transistor is used to give what we might think of as "amplified" smoothing of the power supply output. Its operation relies upon the fact that the bipolar transistor is a current amplifier. It is capable of controlling large currents when supplied with small input or "bias" currents, as we saw in chapter seven.

The general principle of transistor filtering and regulation is that the transistor is made to control the relatively large current drawn by the load circuit by supplying its control electrode — the base — with a smoothed and / or regulated source of bias current. As this reference source is required to supply only the small control current of the transistor, it is a relatively easy matter to provide it with filtering and regulation.

As may be seen from figure 5, the transistor (here an NPN type) has its collector connected to the pulsating DC output of the rectifier. Its base is supplied with smoothed bias current by means of the filter circuit

value given by the product of C2 and the transistor current gain. Thus, it is said to act as a "filter capacitance multiplier."

For example, if C2 has a value of 500uF and the transistor has a gain of 100, the effective filtering is considered to be equivalent to a capacitor of 50,000uF shunted directly across the load.

While this comparison is fairly accurate as far as the filtering is concerned, it is not accurate as far as the source impedance seen by the load is concerned. This point is a little too involved for our purposes at present, but it should be remembered that the concept of "capacitance multiplication" is rather limited in its application.

As mentioned earlier, a transistor connected like that in figure 5 (as an emitter follower, in other words) can also be used to "regulate" the output of a power supply. This means that it can be arranged to keep the supply voltage substantially constant at the correct value, despite changes in the current drawn.

As you might have already guessed, this is done by holding the voltage supplied to the base of the transistor constant, so that the transistor has no choice but to maintain substantially the same voltage at its emitter. Usually the base voltage of the transistor is held constant by using a circuit with a so-called "Zener diode", which is a special sort of semiconductor diode made to be operated in the reverse breakdown condition. The operation of the circuit depends upon the fact that the voltage drop of such a zener diode remains effectively constant for a wide range in currents.

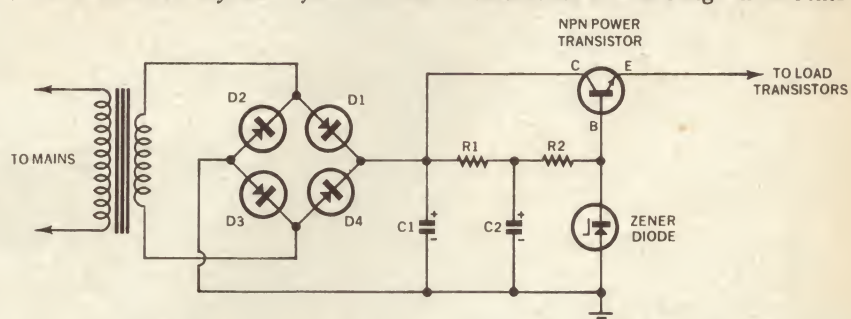


Figure 6: This transistor supply is similar to that of figure 5, but the transistor circuit performs voltage regulation as well as dynamic filtering.

This type of transistor filter circuit is often called a "dynamic" filter, because the filtering is achieved by the transistor effectively varying its instantaneous resistance to compensate for the pulsations at the rectifier output. Because the load voltage tends to duplicate the reference voltage at the base of the transistor, a transistor connected in this way is also said to be connected as an "emitter follower".

The feature of the emitter follower mode of connection which is of particular importance from the viewpoint of dynamic filtering and regulation, is that the load voltage is more or less independent of the transistor collector voltage. As long as there is sufficient collector supply voltage to supply the requirements of the transistor and load, any pulsations or variations present in the collector supply voltage tend to have little if any effect upon the load current and voltage.

Often the action of a dynamic filter is pictured by considering the transistor to have "amplified" the filter capacitor C2 to a

Figure 6 shows the circuit of a very simple regulated power supply using a zener diode. Basically the supply is identical to that of figure 5, but the resistor in the base circuit is now divided into two, with capacitor C2 now connected between their junction and the negative line (which is earthed). The zener diode is connected between the transistor base and negative, holding the base above ground by the diode breakdown voltage.

In closing the discussion of power supplies, filtering and voltage regulation, it should be mentioned that, although the principles of dynamic filtering and regulation have been explained by reference to transistors, the same principles apply to valves. Dynamic filtering is not often employed in valve circuits — principally because it is fairly easy to achieve adequate filtering using normal inductor-capacitor filters — but valve-type voltage regulators are quite often used in test equipment and other equipment requiring well-regulated supply voltages.

THE BRILLIANT NEW

THE BRILLIANT NEW WHARFEDALE RANGE

From the very birth of the term "high fidelity", British manufacturers have set world standards for the design and fabrication of the most outstanding high fidelity sound reproduction equipment.

Famous Wharfedale loudspeakers have outsold every other make of high fidelity loudspeaker manufactured in the United Kingdom. The long experience and the technical "know-how" of the Wharfedale organization combined with recent "state of the art" developments have been applied to the design of several completely new Wharfedale products . . . a complete range of fully compatible audio equipment which produces most effective and completely natural *dimensional* stereo sound reproduction.

Let's look at the new era Wharfedale range:—

THE NEW ERA WHARFEDALE "LINTON" STEREO AMPLIFIER

The new era Wharfedale "Linton" stereo amplifier is attractively styled, power output is 15 watts R.M.S. per channel into 8 ohm speaker loads, and frequency is 30-20,000 Hz. ± 1 dB. at full rated output.

Sensitivity of the new era "Linton" amplifier suits magnetic stereo cartridges at 3.5 mV. and T.H.D. does not exceed 0.1% at 1 kHz. into 8 ohm speaker systems at *full output*.

Tone controls for bass and treble response offer unusual flexibility . . . piano-key switches are provided for *mode, treble filter, tape monitor, tape input, phono input* and *tuner. Ask for a no-obligation demonstration at any Simon Gray dealer!*

THE NEW ERA WHARFEDALE "LINTON" TURNTABLE

Designed to take records of 7", 10" and 12" diameter, the new era "Linton" turntable also features four speeds — 16⅔, 33⅓, 45 and 78 r.p.m.

You may adjust the "Linton" turntable for either Manual or Automatic operation, switch-off and return are automatic, stylus tracking pressure is fully adjustable, a bias compensator is incorporated and the arm lowering device is *hydraulically damped* to *protect your records*.

The magnetic stereo cartridge fitted is the well known Shure M44-7, complete with diamond stylus.

THE NEW ERA WHARFEDALE "LINTON 2" COMPACT SPEAKER SYSTEM

Featuring an entirely new 8" speaker with an oversize magnet which produces exceptional performance, the new era "Linton 2" is both *attractive* and *compact.*

Frequency response is 55-17,000 Hz. ± 3 dB. and power handling capacity is 20 watts DIN. Size is only 19" x 10" x 9½" and finishes available include oiled teak and polished walnut. A new 2" tweeter unit covers all frequencies from 1,200 Hz.

THE NEW ERA WHARFEDALE "LINTON 3" COMPACT 3-WAY SPEAKER SYSTEM

Identical in cabinet design and size to the 2-way "Linton 2", the addition of a 4" mid-range speaker to the speaker complement brings smoother overall frequency response and added "presence" to stereophonic playback.

Frequency response is 55-17,000 Hz. ± 3 dB., and power handling capacity is 25 wats DIN. Size is 19" x 10" x 9½".

THE NEW ERA WHARFEDALE MODEL DC9 CASSETTE TAPE RECORDER

With the Dolby System !

The release of the new era precision built Wharfedale Model DC9 Cassette Tape Recorder heralds a major breakthrough for cassette recording.

Precision tape transport mechanism is used in the new era Wharfedale DC9.
Frequency response 50-12,000 Hz. ± 2 dB., wow and flutter less than 0.18%, signal-to-noise ratio better than 50 dB.

SEE THE NEW WHARFEDALE RANGE AT YOUR SIMON GRAY DEALER !

3-Channel Mixer

Elementary Electronics

by ROSS TESTER

It is a number of years since we published a microphone mixer — more than five to be exact. So we thought it about time to publish another. This mixer, however, is quite different from any we have published in the past — it should not cost more than six dollars to build.

There are many situations where it would be very convenient to be able to mix the outputs from a number of signal sources. This little mixer, with three input channels, will do a first class job, in spite of its simplicity.

We would envisage that it would be quite acceptable for use at school concerts, speech days, etc. Therefore, it would make an interesting and economical project for members of Youth Radio Clubs, etc.

Each channel has an input impedance of 280K and is suitable for use with any medium to high impedance dynamic microphone. It will give approximately 30mV out for 5mV in, thus making it suitable for feeding into the preamplifier of a PA amplifier, tape recorder, etc.

The input impedance is too low for crystal microphones, but it should be possible to modify the circuit to suit. For any input intended for a crystal microphone the potentiometer and associated resistor should be increased to 4.7M. The unit can use a mixture of crystal and dynamic input channels if desired.

However, be aware that such high impedance circuits are much more prone to hum pick up. Where they are used it may be necessary to shield the mixer completely, inside a metal box. For these, and other, reasons the dynamic microphone is generally to be preferred to the crystal type.

Another possibility is to use one of the channels for a crystal pickup, rather than a microphone. A crystal pick will have a much higher output than a dynamic microphone, and also requires a much higher load impedance to deliver a proper bass response. The easiest way to cope with these two requirements is to connect a resistor of about 2.2M in series with the active lead from the pickup. This resistor may need to be shielded to prevent hum pick up.

The front panel of our mixer. The layout is not critical and other panel arrangements could be used.

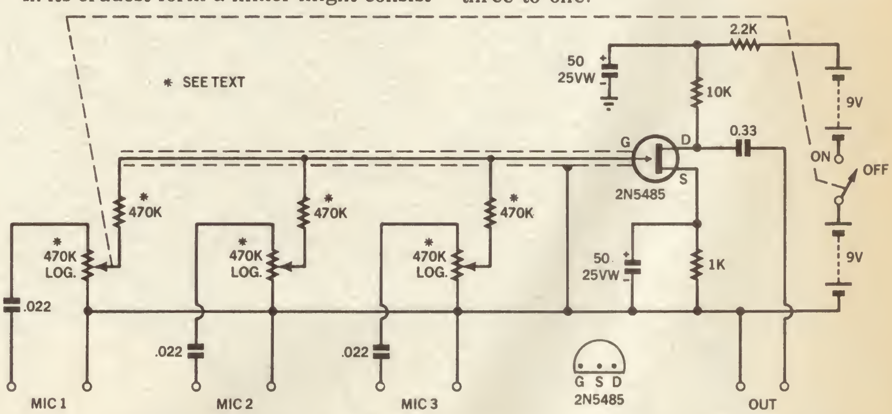
How does this mixer circuit work? It is what is called a passive system, since it does not depend on active devices such as valves or transistors for the mixing functions, as such. It consists simply of three pots, as volume controls, and three resistors of the same value.

In its crudest form a mixer might consist of just three pots, with their moving arms connected together and fed to the amplifier input. Such an arrangement would work — in a fashion — but would suffer from very serious interaction. For example, if the moving arm of any one pot was turned to the full off position, it would kill the output of the other two.

This is the reason for the isolating resistors in series with the arm of each pot. Even when a pot is turned fully off, there is enough resistance between it and the rest of the circuit to minimise its effect. Note that we say minimise, because it will have some effect. However, it will be slight, and of little practical importance.

As might be expected, a simple circuit like this must impose some penalty. The penalty is an overall loss in the network, and this is one reason we follow it with an amplifying stage.

The amount of loss depends on the number of input circuits we provide. In the simplest case, where we mix only two inputs, the loss will be two to one in the worst situation. That is to say, with one input turned full on, and the other right off, only half the signal fed to the input will appear at the output of the mixer. With the three stages shown, and two turned off, the loss is three to one.



The circuit of the mixer. The mixing circuit proper consists of the three 470k pots and their associated 470k isolating resistors. The amplifier stage helps make good the losses in the mixer network.

Output from the mixer network goes to the amplifier stage, a 2N5485 FET in this case. The high input impedance of the FET is well suited to this application, since it minimises any loading on the mixer network.

The voltage gain of the mixer is determined by the gain of the FET, less the losses in the mixer circuit. The gain of individual FETs varies widely, but we would expect it to be somewhere around 20. In our case, a 5mV signal fed to one channel, with the other two off, gave an output of 27mV, or an overall gain of a little over 5. Allowing for a 3 to 1 loss in the mixer, this gives a gain in the amplifying stage of about 16.

The output impedance is approximately equal to that of the drain resistor, or 10K. This means that a main amplifier with an

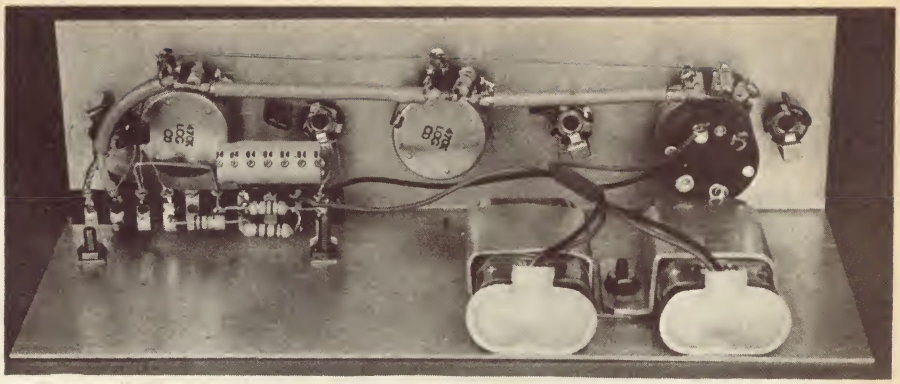
input impedance of around 50K would not seriously load the mixer. As the impedance is reduced below this point there will be some increase in distortion but, considering the limited signal level in this part of the circuit, it should be safe to work into a 20K load without a serious increase in distortion. It would be unwise to go below this value.

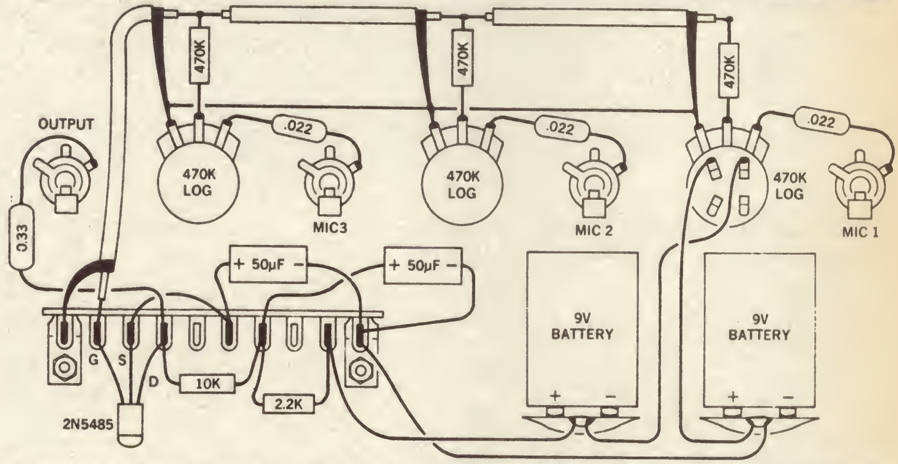
Note that the supply line to the FET drain is decoupled with a 50uF electrolytic capacitor and a 2.2K resistor. The main purpose of this is to minimise a rather disturbing "crack" which can occur in the speakers if the mixer should be switched on or off while the main amplifier is running. Even with this network there may still be a "thump", and it is a good idea to turn the main amplifier gain down before switching the mixer on or off.

Perhaps the best place to start in the construction of the mixer is the metalwork. A simple "L" shape bracket, as shown in the illustrations on the right, should present no problems, even for the novice.

We made our mixer on a piece of scrap aluminium measuring 7½in (190mm) wide by 5¼ (133mm) deep, bent at right angles 2in (51mm) from the top. This gave us a compact unit, which could be used as it was, or built into a case. However, these dimensions are not critical, and, providing adequate care is taken with shielding, no problems should result from any change in layout. In fact, a change may be preferred, as some operators find it annoying to have the jacks emerging close to the control pots.

Once the holes are drilled, the aluminium can be bent as indicated. Hold it in a vyce, between two pieces of metal with a good straight edge. Line the aluminium up with the straight edge, and tighten the vyce. Then, with a block of wood, bend the aluminium until it is as close as possible to a right angle. Then take a hammer and a block of wood, and strike the block while moving it back and forward along the bend until it is square.





A photograph and wiring diagram of the mixer, presented together for comparison. Compare them with the circuit on the opposite page.

PARTS LIST

Resistors: (1/2 watt)
1 x 1k
1 x 2.2k
1 x 10k
1 x 470k
2 x 470k log pots
1 x 470k log pot with switch
Capacitors:
3 x .022uF LV ceramic or polyester
1 x 0.33uF LV ceramic or polyester
2 x 50uF 25VW
1 x 2N5485 FET
3 x input sockets (see text)
1 x output socket (see text)
2 x 9V batteries with connectors (Eveready 216 or sim)
3 x knobs to suit
3 x ½in, ⅛ Whitworth csk head screws and nuts.
1 x 10 lug tagstrip (E-8-E)
2 x battery clamps (see text)
1 piece 18-20SWG aluminium, size to suit.
1 length shielded cable, approx 8in. (200mm)
1 length tinned copper wire (or hookup wire), approx 6in. (150mm)
1 sheet Letraset (for front panel labels if required).
Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.

Next, the pots and jacks should be fitted, and the input components soldered between them. Wire the tag strip before mounting it, soldering the FET in place last to minimise risk of damage to it due to excessive heat.

It should be possible to wire the mixer completely using only the circuit diagram, but for those with limited experience we have provided a photograph and a detailed wiring diagram. Using all these sources of information, even the beginner should have no trouble.

We used countersunk-head screws to fix both the tagstrip and battery clamps. The head should be flush with the underside of the base, so as not to scratch any surface they might be put on. Four rubber feet in the corners would also preclude this from happening.

Shielded wire should be used for all the signal circuits. This is necessary to minimise hum pick up from stray AC fields, and also RF energy from any nearby radio or TV transmitters. If hum or RF pickup should still be a problem, it may be necessary to enclose the wiring completely, in a metal box.

For those not used to handling shielded cable, a few points may help. When soldering to either the inner conductor, or the outer braid, take care not to damage the insulation between them, which has a low

melting point. Experiment on a few scrap lengths first.

If the outer shield is simply wrapped around the insulation, it is quite easy to separate the two. If it is braided, we suggest that you push the strands of the braid apart until there is a hole large enough to allow the inner conductor to be pulled through it. Again, experiment with a scrap.

We have not shown any diagram for the battery clamps. These are made by bending a piece of thin metal around the batteries themsleves, and then drilling the mounting holes. You may use thin aluminium, as we did, or tinplate, etc. They are both secured to the chassis by the same screw, and the batteries are clamped underneath.

The batteries in are connected in series, with the on-off switch between them. Putting the switch in this position is convenient because the switch now also serves as an anchor point for the connection between the two batteries.

Some readers may think we have forgotten part of the wiring around the input sockets, as these appear to have only one connection made to them, rather than the two shown in the circuit. The explanation is simple; mounting the sockets on the metal panel makes contact to one side of them, and we use the metal panel as a common conductor.

Note that, while we can employ this technique in a simple battery operated device like this, there are many situations where it would not be satisfactory. Particularly where AC from a power supply may flow through the metal chassis, there is a high risk of hum pick up. In such cases all such terminals should be insulated from the chassis and wired to a common point.

After finishing the wiring unscrew the tagstrip and battery holders, remove the nuts from the potentiometers and sockets, and lift the whole of the circuitry out. Then you will be able to polish the front of the panel with some fine emery cloth, which removes the marks and scratches from it. Then, to provide a neat finish, "scratch grain" the panel with a wire brush. This is done by holding the aluminium over the corner of a bench, and scratching the surface with a wire brush, in one direction only.

Taking care not to touch the front again, make up the lettering using "Letraset" or similar rub-on lettering. The "Letraset Printpack" is an economically priced pack well suited to small jobs of this kind. Even the dots which mark the pot positions are made this way. The Letraset Printpak No 8 would be the best to buy. It contains type 3 and 4mm high, which would be suitable for most panel marking.

Finally, give the whole panel a fine coat of clear flat enamel from a spray pack. This protects the surface from fingermarks and also stops the letters from lifting.

Then re-assemble the circuitry on the panel. It may seem a little odd to remove it all after the job is completed, but if the lettering is done in the preliminary stages it will almost certainly be damaged in some way. In any case, the way we assembled the circuitry makes it easy to remove in one lump.

And that's about all there is to it. Follow our instructions carefully and you should have a versatile little unit which will increase the usefulness of any amplifier by a very large factor.

Elementary Electronics: Ideas Worth Trying

Low Cost Reversing Light For Cars

I was confronted with the need to fit backing lights to my car. As the car was new, I did not wish to mar the appearance by fitting additional lights, so I fitted the following additions to the flasher circuit, to make the flasher lights double as reversing lights.

I bought a reversing switch and fitted it to the place provided on the gearbox. Most cars — even fairly old ones — have provision for the switch on the gearbox. The reason for this is that in the past, only the luxury versions had reversing lights, but the gearbox housing used was the same as in the standard models. This is especially true of Continental cars.

As can be seen from the circuit diagram, the rear orange turning indicator lamps can be used as reversing lights merely by bypassing the flasher mechanism, and isolating the front and rear circuits by means of silicon diodes. This method does not alter the outward appearance of the vehicle, but the increased night safety plus the low cost — the price of four diodes plus the switch — should make this idea popular with owners of both old and new model cars.

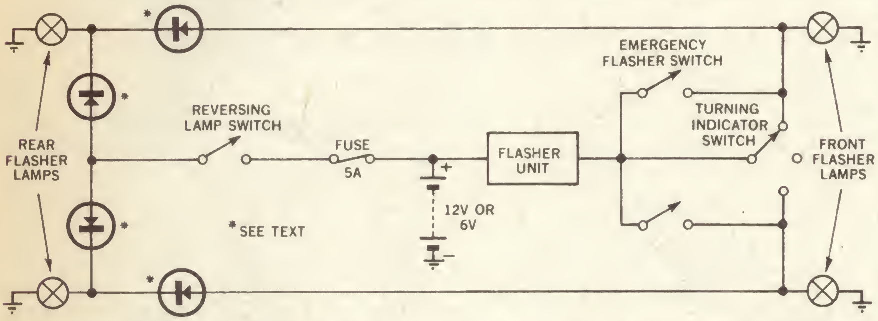
Some readers may have cars with no provision for a gearbox switch. If this is the case, a switch could be mounted on the dashboard to perform the same function. If this is used, there should be some sort of warning lamp to indicate that the reversing lights are on. This may be a legal requirement in some states.

The diodes should have a PIV at least equal to the maximum voltage likely to be generated in the car's electrical system, and a current rating equal to the surge (cold) current of the lamps. The largest flasher lamps appear to be 18W types; 1.5A at 12V or 3A at 6V. Assuming a cold resistance of about one eighth of the hot resistance — which appears to be typical — the surge current in a 6V system could be about 25A.

On the basis of these figures, the most logical choice is the type of diode used in vehicle alternator systems. These are usually rated at 25A continuous, with a surge rating well in excess of this, and a PIV of around 200. A typical type is the BYX21L/200. This type of diode also represents about the best value for money available, considering the ratings and the safety margin which they represent.

Also, with ratings of this order it may be permissible to omit the two diodes isolating the front flasher lights, particularly in 12V systems. This would mean that the front lights would be energised as well as the rear ones, but there does not seem to be any serious objection to this.

(Idea submitted by: Mr L. Junor, Bronaldi St, Heathmont, Victoria 3135.)



The addition of four diodes, a reversing light switch, and a fuse, added to a conventional flasher circuit, enables the flasher lights to double as reversing lights.

IC OFFER — SPECIAL ANNOUNCEMENT

Reader response to the special offer of a low price linear IC in our April issue was quite overwhelming. Fairchild Australia Pty Ltd had a stock of many thousands of the FuA703 devices, but within two weeks of publication of the April issue we were advised that Australian stocks had been virtually exhausted. Additional supplies were ordered immediately from overseas, but there has been an unavoidable delay in servicing some reader requests. Fairchild Australia and Electronics Australia apologise for any inconvenience created by this delay.

NOTE: Because of the enormous response to date and the limited overseas supplies of these devices, the offer must be closed to Australian readers on Friday June 9th. Coupons and remittances which reach Fairchild Australia later than this date cannot be serviced, and will be returned with apologies. However New Zealand readers are assured that stocks are being reserved for them.

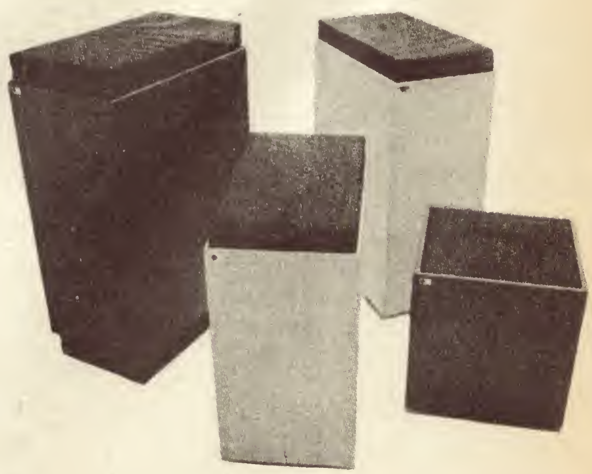
The amazing case of the house with the moving walls.

This is a house in Frenchs Forest. With moving walls.
It's true.
They move outwards.
Before your very ears.
The explanation has nothing whatever to do with the supernatural.
Or at least not as we normally understand it.

The reason — the owner has a pair of Sonab speakers.
Sonab speakers are omnidirectional.
They fill an entire room with rich true stereo sound.
Instead of that one short static line you get from conventional forward facing systems.
But they also have another unique feature.

Listen to Sonab speakers, close your eyes, and you'll find that the effect is of moving the walls behind the speakers outward. Away from you. The whole room seems to open up. It's a difficult phenomenon to describe. But it's one that every Sonab owner has experienced.

If you're cynical there's only one way to prove it to you.
We'd like to come demonstrate the effect in your own home.
Just invite us.



Sonab

Sonab of Sweden Pty. Ltd., 114 Walker Street, North Sydney, N.S.W. 2060. Telephone: 929 4288/4554.

CLASSICAL RECORDINGS

Reviewed by Julian Russell

Holst's Planets Suite — "exciting performance"

HOLST — The Planets (suite). Los Angeles Philharmonic Orchestra with the female voices of the Los Angeles Master Chorale conducted by Zubin Mehta. Decca Stereo SXL6529.

For the benefit of those to whom this splendid work is unfamiliar — and there cannot be many among the readers of this column — Holst used the planets in their astrological sense. Thus the first, Mars, is sub-titled The Bringer of War. Mehta starts it quietly, using a steady, sinister rhythmic tempo restrained in dynamics until the first climax, which is altogether shattering. The dirge-like middle section is in effective contrast and the playing and recording are quite wonderful.

In Venus, the Bringer of Peace, I thought the four-note rising phrase on the horn lacked variety in its many repetitions, and later, the violin solo a bit sentimentalised. Mehta's reading is highly individual. It suggests to me to try to express the deep joy of peace and not, as is more usual, its easy, cool security.

Mercury, the Winged Messenger, has quicksilver slipperiness instead of the customary fleetness though it too is beautifully played right up to tempo. Later, at the entrance of the solo violin, it seems to get altogether too rarefied and generally speaking something more definite in the way of contrasts would have been welcome.

I think most will agree that Jupiter, the Bringer of Jollity, is a complete success. Mehta's reading has true Jovian jocularity, full of rumbustious belly-laughter. In the middle section the great open-air hymn-like tune is given truly majestic stature. Playing and recording alike are peerless. In the opening bars of Saturn, the Bringer of old Age, you have hopeless, comfortless wind chords against superbly recorded double basses. The weariness of the slow march-like theme in the middle section also comes off splendidly. Mehta tries to shake off this weariness in a restrained climax raised to just the right level. And the piece ends with the threatened change of senility into dissolution.

Uranus, the Magician, offers just the right mixture of musical sleight of hand and swaggering braggadocio. By the way have Queensland readers ever noticed how much the opening four notes resemble the call of their butcher bird? The inspiring dotted note march, which starts off way down in the lowest brass and goes all the way up to high piccolos, leads to an altogether magical effect of a sudden change from ultra fortissimo to barely heard pianissimo which nearly had me jumping out of my seat.

I must confess to having been disappointed in Neptune, the Mystic. Holst in this takes you right out into the unbearable cold of interstellar space. But I thought Mehta's interpretation altogether too prosaic, without even a hint of mystery or blackness. And even when the well-drilled choir enters with its quiet, wordless chorus, there is no improvement. But, for the rest, if you're willing to suspend preconceived ideas about how the different components of this suite should go, this is an exciting performance, give or take an occasional bar.

★ ★ ★

DEBUSSY — String Quartet in G Minor. BLOCH — String Quartet No. 3. The Carl Pini Quartet. EMI Stereo SOXLP 7540.

The critics I have read have been so ecstatic in their praise of Carl Pini's activities since he arrived in this country that I approached this, his debut recording, with some humility. I needn't have bothered. Recorded for EMI in Australia its string tone is coarse and recorded so close to the microphone that you have to turn the volume control way down not to be blown out of the room. But even after having done so the violins sound very edgy and the cello is seldom heard, except in solo passages. Despite this the playing technically is always good and much hard rehearsal must have gone into achieving the excellent sense of ensemble between all four players.

But no one will ever convince me that Pini's is the way to play the Debussy Quartet. Climaxes, closely approaching hysteria, rear up from time to time. High solo violin passages are often almost unbearably sentimentalised. There is hardly ever a moment of relaxation. Everything is much too hard-pressed. In fact to my mind it is simply just not Debussy.

This treatment is better suited to Bloch's not very interesting Third String Quartet. The work except for a bar here and there, is quite without the strongly felt Hebraic quality of much of his other work, so often redolent of Old Testament. Instead in the first three movements you have some well-knit commonplaces, admittedly admirably played, but to me quite devoid of real musical interest. The Finale is a little more acceptable since according to the sleeve notes, it is based on a 12-tone row developed almost strictly diatonically, an unusual treatment that, at any rate, keeps the mind busy if it seldom involves the emotions.

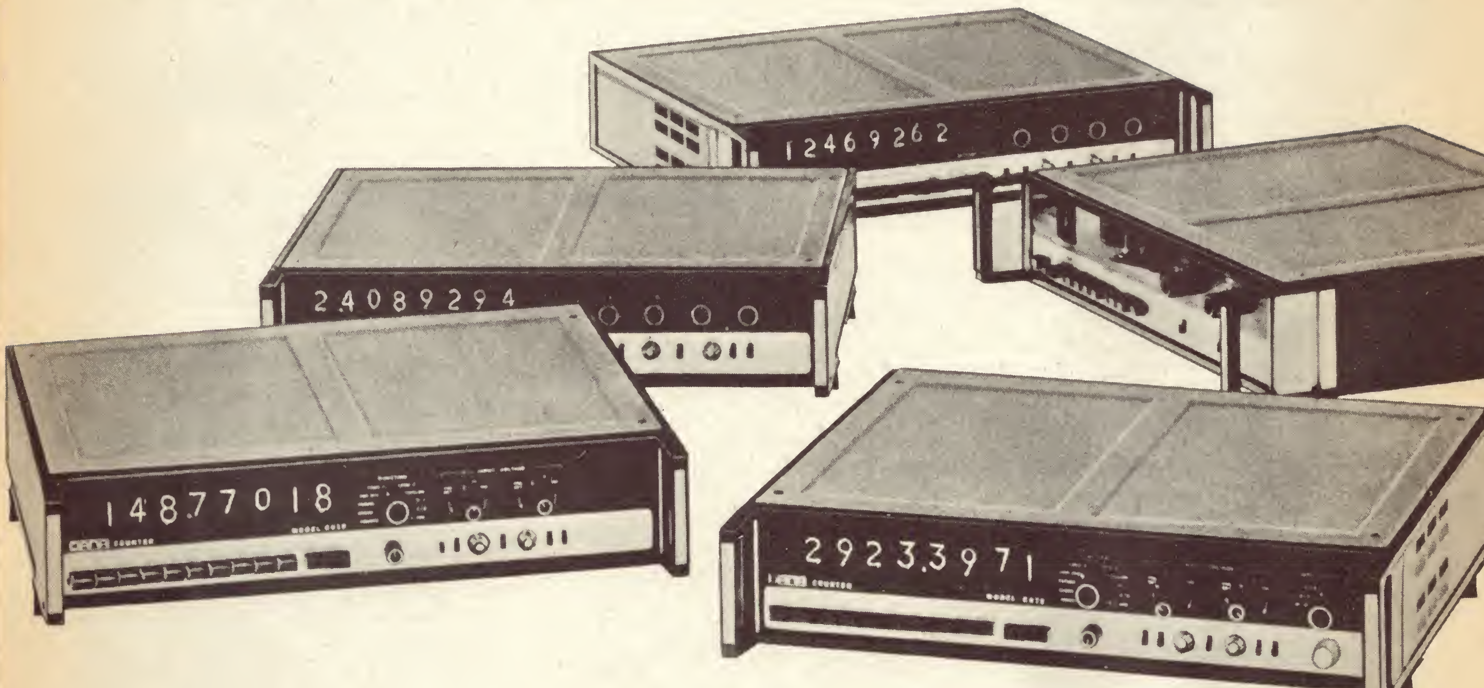
★ ★ ★

PROKOFIEV — The Two Violin Concertos. Nathan Milstein (violin) with in No. 1 the Philharmonia Orchestra conducted by Carlo Maria Giulini, and in No 2, the New Philharmonia Orchestra conducted by Rafael Fruhbeck de Burgos. World Record Club Stereo S / 5021.

If you can enjoy these two concertos played with faultless technique if little else and issued to members at a budget price, this disc is certainly for you. To me they are strangely passionless. They sound as if they mean little to Milstein, or if they do, he fails to register the fact. His approach to these two essentially lyrical scores is altogether too cool, even mechanical. He gives you too much metronomical fiddling better suited to the baroque school. Moreover he is oddly unobservant of the composer's expression marks, and subtleties of dynamic nuancing are almost non-existent, despite obvious encouragement from the two different conductors who direct the orchestral parts.

As I said earlier, technically Milstein's playing is exceptional, but emotionally — not for me. Try the Isaac Stern recordings of these concertos and you will hear what I mean. Sound is good average.

five new counters



- **0-550 MHz**
- **4 MEASUREMENT MODES**

DANA®

8000B Series

For further information contact
Australian Representatives

JACOBY MITCHELL

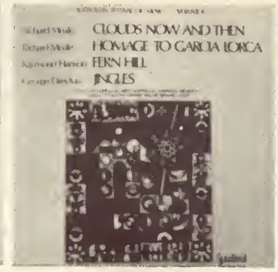
SYDNEY ...... 630 7400 BRISBANE 44 4674
MELBOURNE 41 7551 ADELAIDE 93 6117
PERTH 28 5725

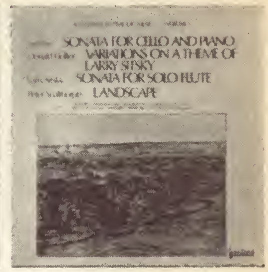
Digital Electronic Counters for versatility and reliability *without* multiple plug-ins.

Each counter in the series provides 4 measurement modes: Frequency, Period, Multiple Period Average and Totalise. An additional 4 modes are available on some models providing extended frequency range to 550 MHz, Time Interval, Time Interval Average and Frequency Ratio.

NO LONG WARM-UP DELAY. This is eliminated by use of a TCXO, which also achieves optimum versatility and accuracy in a general purpose counter. (A higher stability TCXO and a range of oven oscillators are options.)

INPUT SENSITIVITY. Normally 50 mV to 550 MHz while an optional amplifier will increase this to 1 mV with automatic triggering. This high sensitivity allows frequency measurements with up to 99% AM present on the signal.





VOL. 1. ALFRED HILL — Symphony "Joy of Life".

JAMES PENBERTHY — Cantata on Hiroshima Panels. Soloists, the Adelaide Singers, Adelaide Philharmonic Choir, South Australian Symphony Orchestra conducted by Patrick Thomas.

VOL. 2. NIGEL BUTTERLEY — Explorations for Piano and Orchestra. Ian Farr (piano) with the Sydney Symphony Orchestra conducted by Moshe Atzmon.

JOHN ANTILL — Momentous Occasion Overture. Sydney Symphony Orchestra conducted by Antill.

CLIVE DOUGLAS — Three Frescos. Sydney Symphony Orchestra conducted by Moshe Atzon.

VOL. 3. FELIX WERDER — Concerto for Violin. Leonard Dommett (violin) and the Melbourne Symphony Orchestra conducted by Fritz Rieger.

MARGARET SUTHERLAND — Haunted Hills. Melbourne Symphony Orchestra conducted by John Hopkins.

VOL. 4. RICHARD MEALE — Clouds Now and Then. Homage to Garcia Lorca. West Australian Symphony Orchestra conducted by John Hopkins.

RAYMOND HANSON — Fern Hill. Molly McGurk (soprano) with the West Australian Symphony Orchestra conducted by Sir Bernard Heinze.

GEORGE DREYFUS — Jingles. West Australian Symphony Orchestra conducted by Sir Bernard Heinze.

VOL. 5. IAN FARR — Sonata for Cello and Piano. Gregory Elmaloglou (cello) and Nigel Butterley (piano).

DONALD HILLIER — Variations on a Theme of Larry Sitsky. Carl Pini (violin) and Beryl Potter (piano).

LARRY SITSKY — Sonata for Solo Flute. Margaret Crawford (flute).

PETER SCULTHORPE — Landscape for Piano with feedback and pre-recorded tape. David Bollard (piano).

After a long absence from the field of classical record production Festival have reappeared with a massive issue listed above. Moreover more are promised for release later this year. It is a joint venture with the Commonwealth Assistance to Australian Composers, APRA, and the Australian Broadcasting Commission. For many years now the ABC has prudently recorded on tape and disc performances of Australian and other music which they considered important enough to preserve. The result has been the acquisition of a rich library to which access has been very strictly limited.

The standard of production is very high indeed. The sound is mostly first class, the discs have a fine finish and each is presented in double-fold covers decorated with beautifully reproduced prints of Australian paintints. Also featured are the photographs of the composers and performers.

To avoid confusion I shall take them in numerical order though it will soon be apparent that that is not the way in which my interest lies. In Vol. 1 Alfred Hill's symphony, "Joy of Life", shows almost every influence of the 19th century German and other Central European romantics but despite this the first second and third movements still have much innocent charm. But in the choral finale — "Gloria in Excelsis Deo" — Hill tried to be grand but succeeded only in being banal, a kind of poor man's Liza Lehmann. This was not Hill's line of country at all. His small talent was better suited to more modest endeavours. Both the playing and singing offer much to enjoy and the sound is first rate.

James Penberthy's "Cantata on Hiroshima Panels" is much sterner stuff though still well within the range of popular appreciation. Though conventional melodically and harmonically it conveys eloquently the composer's deep sense of outrage at the Hiroshima nuclear slaughter. His expressive vocal line has very professionally scored orchestral accompaniment. Again the playing, singing and recording are of a high standard.

In Vol. 2 those who know their way around contemporary music should find no difficulty with Nigel Butterley's "Explorations" the first time through. Indeed, to me, it sounded more impressive at first hearing than at subsequent repetitions. There is nothing way-out about the composition. It is very expertly put together in an idiom that even today (it was first performed to celebrate the Captain Cook Bi-Centenary Celebrations in 1970) already sounds a little dated. It certainly has an occasional impressive, even moving sequence, but on the whole I prefer Butterley in his more pious moods. The SSO under Moshe Atzmon provide a well balanced background to Ian Farr's splendid performance of the solo piano part. In the following notices you can take it for granted that unless I specify otherwise the engineering is always of a very high quality.

John Antill's "Momentous Occasion Overture" was, I felt, composed in a mood of dogged high spirits — come what may. It was, however, eminently suited to the occasion which it celebrated, the 10th anniversary of the ABC's Youth Concert series. Antill may not have very much to say here but he communicates everything in a very civilised language.

In his "Three Frescos" Clive Douglas's use of dissonance seldom disguises the conventionality of his musical thoughts. The music is all very worthy, at times warmly melodious and always colourfully orchestrated. One might describe him, with some reservations, as an Australian Respighi. The SSO again plays accurately and expressively, the Antill work under the baton of the composer, the Douglas under Atzmon's.

Felix Werder's Violin Concerto is a compact work unrelenting in its logic but with some fine lyrical moments. Werder is also, of course, a critic of no mean — and perhaps sometimes very mean — perspicacity. His highly amusing sleeve comments on the concerto as a musical form would be well worth reprinting here except for the warning that they are the author's copyright. A pity because, unlike his concerto, there's a laugh in every line. Leonard Dommett gives an entirely satisfactory account of the solo violin part and Fritz Rieger's conducting of the MSO advertises his complete sympathy with this type of exercise.

The coupling, Margaret Sutherland's "Haunted Hills", offers a not altogether suitable contrast to the Werder concerto. I don't think I would have chosen it as representative of Miss Sutherland at her best though for the most part it retains an air of freshness that remains, despite familiarity with the score. It is in two parts and it is in the second part that the composer's invention seems to lag to an extent that makes the conductor, John Hopkins, appear to have some difficulty in sustaining the scherzando instructions given by the composer. However when one remembers that Miss Sutherland was born in 1897, only 7 years after the late deeply revered Alfred Hill, the originality of her talent is much to be admired.

If I had to choose one out of the five, Vol. 4 would have my unqualified preference. It was the first one I played and is still the one to which I return most frequently. On the first band, in "Clouds Now and Then" you have Richard Meale in a mood poetically evocative of the title. Listening to it, it is not difficult to imagine yourself lying on your back in scented grass idly watching drifting clouds. Sometimes you think of them, sometimes of other things, as Meale might have intended you to do in his eclectic

mood. Some give rain — there is a little stormy passage — others just pattern the sky. The playing of the West Australian Orchestra is purposeful, John Hopkins' conducting shows complete understanding of and devotion to this lovely sound.

Homage to Garcia Lorca is probably, in the widest sense of the word, Meale's best known work and Sir Bernard Heinze leads the WA Orchestra through it with particular attention to the music's moving poignancy. But I felt that he was not as well served by the WA strings as he might have been. Their tone tends to wiriness, though this might be due to the engineering. But even this does not spoil the overwhelming effect of the great final climax. Raymond Hanson's Fern Hill is a setting of a Dylan Thomas poem, the text of which would have been welcome since Miss McGurk's diction is so unclear that only an occasional word can be understood. And despite Heinze's paternal handling of the colourfully scored orchestral part her soprano sometimes sounds a little backward. Otherwise it is clear, fresh and accurately pitched.

That irrepressible prankster George Dreyfus is again elegant and witty in his Jingles. In this suite of parodies of all kinds of music, classical and popular, he is at his wittiest best. Listening to them I was constantly reminded of Max Beerbohm's similarly elegant exercise, but in the literary medium, in his Savanorola Brown. It is a piece it will take me long to tire of and Heinze relishes its humour as the good raconteur he is. There is no rib-digging. He lets every bar speak sparklingly for itself.

The outstanding piece in Vol. 5 is Sculthorpe's Landscape, in which the solo pianist improvises at times on the predetermined sounds on a pre-recorded tape. Sculthorpe struck gold, in every sense of the word, with his Sun Music series and in this piece, too, I, at any rate, could again feel the same sun glaring from a tape that shudders, clicks and glitters. David Bollard's improvisations occasionally sound a little too mellifluous against Sculthorpe's background though there are passages when the blending of the two minds seems complete. I wonder if these were some of the pre-determined bits? Sculthorpe is an inexhaustible explorer into musical "effects" and some displayed here are ingenious and, to my ear, original. An interesting short piece that will bear much repetition.

Margaret Crawford offers some delicious flute playing in Sitsky's unaccompanied Flute Sonata. But was it necessary to record so close that her breathing often becomes part of the entertainment? But this apart, she has a lovely reedy tone in the low register and unforced brilliance in the higher. Sitsky's work, an earlyish one, shows some allegiance to Honegger's short piece for solo flute, The Goat; though where the Honegger piece is just long enough, Sitsky's, without Honegger's sense of humour, seems to me to go on far too long.

Ian Farr's Sonata for Cello and Piano is a fashionably fragmented exercise, typical of those heard, usually once only, at avant garde music festivals. It is, however, brilliantly played by Elmaloglou and Butterley.

Hollier's set of variations shows considerable technical resources by the composer and the performers, Carl Pini and Beryl Potter.

VARIETY FARE

REVIEWS OF OTHER RECORDINGS

Devotional Recordings

IT'S REAL. Dale Evans, with orchestra and chorus conducted by Anita Kerr. Stereo, Word WST-8546-LP (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals).

Dale Evans and her husband Roy Rogers are well known for their leadership among the evangelical community in Hollywood. In presenting this album Dale Evans says: "Our Lord . . . has proved himself to me over and over again, through very deep waters." The titles:

Standin' In The Need Of Prayer — Old Time Religion — When I Met My Saviour — Every Time I Feel The Spirit — One More River — Ezekiel Saw The Wheel — It's Real — Deep River — Oh Saviour — Nobody Knows The Trouble — Onward Christian Soldiers — Joshua Fit The Battle.

An experienced Gospel vocalist, Dale Evans is skilfully backed by Anita Kerr and her music, providing variety and avoiding any risk of the solo voice becoming monotonous. This one should have a ready appeal in Gospel circles. (W.N.W.).

★ ★ ★

EXCERPTS FROM A CHORAL CONCERT. The Choir of the Peace Memorial Church, Castle Hill, Sydney. Conductor Fred Grice; Soloist Elaine Abrahams; Organist Bev. Shadlow; Pianiste Elizabeth Cannon. Parker, Mono PR-004.

In a few short years Castle Hill has changed from a quiet farming community on Sydney's western fringe to a thriving suburb. During the same period, a tiny Baptist cause has built and outgrown one church and has just opened a fine new building to accommodate 500 worshippers.

The vitality of this young church is reflected in the choir which features in this LP. As a suburban church choir it is well above average. As a recording group, it has potential but the female voices in particular need more discipline to achieve the ultimate roundness and the polish that distinguishes a "professional" group from enthusiastic choristers. Evaluated at this level, you may find the program to your liking.:

Gloria — The Lord's Prayer — Amen — Lead Me, Lord — King All Glorious — This Little Light — The Lord Is My Light — Jacob's Ladder — Jesu, Joy Of Man's Desiring — My Shepherd — Peace In The Valley — Hallelujah Chorus.

In terms of quality, the general balance is good, with just a trace of edginess on a wide-range system. (From Parker Recordings, 9 Carmel Place, Winston Hills, 2153. Price $3.99 plus 50c pack and postage.) (W.N.W.).

★ ★ ★

HIS NAME IS WONDERFUL. Norma Zimmer & Jim Roberts. Stereo, Word WST-8541-LP. (From Sacred Productions Aust., 181 Clarence St, Sydney and other capitals).

Per medium of Lawrence Welk and network television, and also the Billy Graham crusades, Norma Zimmer and Jim Roberts are well known to American audiences. With duet arrangements of well known hymns, their album could be quite commonplace. It isn't, because of excellent orchestral support, a polished performance and a feeling of personal conviction and involvement.

The tracks: His Name Is Wonderful — Every Moment Of Every Day — He Lifted Me — When I Kneel To Pray — I Would Be Like Jesus — Sweet, Sweet Spirit — His Gentle Look — Take Up Thy Cross — He Touched Me — Beyond The Sunset.

I noted a slight surface prickle on side 2 of this American pressing but the quality and balance is otherwise first class. I think you'll enjoy this one. Recommended. (W.N.W.).

★ ★ ★

NEGRO SPIRITUALS. George Browne, Martin Lawrence, Isabelle Lucas, Geoffrey Taylor and the Linden Singers. World Record Club stereo S / 2005.

Old time WRC members will recognise this disc, which has been reissued periodically (presumably because of demand by new members) since it first appeared in the Club catalogue more than 10 years ago. I have heard it described as "the finest negro spiritual record ever made" or "a beaut disc" by enthusiastic owners. The fact that the recording was made in London, and that there is not a single negro in the group, might surprise some of these people. Yet this is probably the reason for the disc's success. It is a restrained performance, without any of the emotional and vocal excesses which characterise so many performances by negroes in material of this kind. It is, in fact, very much a white man's view of negro spirituals — and will appeal as such to the listener.

The contents are pretty predictable: Jericho — Nobody Knows — Little David — Sometimes I Feel — Lily of the Valley — Gospel Train — He's Got the Whole World — Shadrak — Go Down Moses — Deep River — Sweet Little Jesus Boy — Heaven — Swing Low — Standing in the Need of Prayer. The sound is definitely dated, but is acceptably clean. (H.A.T.).

★ ★ ★

ROCK GOSPEL. The Key To The Kingdom. Various Artists. Stereo, Tamla Motown (EMI) STMLO-10080.

If you like Gospel rock, Gospel happenings and that kind of sound, this album may well be for you, particularly as it contains tracks by a variety of artists:

Hey Lordy (Bobby Taylor) — Sinner Man (Valerie Simpson) — May His Love Shine (The Supremes) — God Bless The Child (Blinky) — Bridge Over Troubled Water (Jackson 5) — As Heavy As Jesus (Stoney & Meatloaf) — What A Friend We Have (Impact of Brass, Joe Hinton) — Jesus Is The Key (Ken Christy & The Sunday People) — There Is A God (Valerie Simpson) — God Is Love (Marvin Gaye) — How Great Thou Art (Gladys Knight & The Pips).

Some of the tracks are more restrained than others but this fact would not be enough to commend the record to me, personally. However, if this kind of music turns you on, there is no need for apprehension about the ability of the performers or the quality of the recording. (W.N.W.).

"Instrumental, Vocal and Humour . . .

RIMSKY-KORSAKOV'S GREATEST HITS. Various artists and orchestras. RCA Red Seal stereo LSC-5012.

RAVEL'S GREATEST HITS. Various artists and orchestras. RCA Red Seal stereo LSC-5002.

Here are two of the latest releases of tracks from earlier RCA discs in the company's "Greatest Hits . . ." series, containing popular classics and excerpts from longer works of the most famous composers. Some tracks are fairly obviously a bit long in the tooth, but most seem to be of quite recent origin, with good modern sound. The usual orchestra / conductor combinations of the past and present RCA catalogue are mostly featured — Boston Pops / Fiedler; The Philadelphia / Ormandy; Chicago Symphony / Reiner and Martinon; RCA Or-

Reviews in this section are by Neville Williams (W.N.W.), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.) and Gil Wahlquist (G.W.).

chestra / Kondrashin; Boston Symphony / Munch; London Symphony / Previn — and with such performers, the results could hardly be less than satisfactory, and some of them can be rated considerably higher than this, e.g., the excerpts from "Scheherazazade" in the Rimsky-Korsakov selection.

The Rimsky-Korsakov disc has: Flight of the Bumble Bee — The Young Prince and the Young Princess, Festival of Bagdad, The Ship Goes to Pieces on a Rock (all from "Scheherazade") — Procession of the Nobles from "Mlada" — Song of India — Bridal Procession from "Le Coq D'Or" — Excerpts from "Capriccio Espagnol" — Tsar Saltan March. The sound in the "Song of India" track is below standard, and has noticeable tape hiss. On the Ravel disc: Bolero — La Valse — Daphnis and Chloe — Pavane for a Dead Princess — Rigadon from "Le Tombeau de Couperin" — Alborado del Gracioso — Feria from "Rapsodie Espagnole". (H.A.T.).

★ ★ ★

THE GREAT CANTATAS (J. S. BACH) VOL 10. Soloists with the Heinrich Schutz Chorale of Heilbronn and the Pforzheim Chamber Orchestra conducted by Fritz Werner.

This series has been running in the World Record Club catalogue for some months, and we draw it to the attention of readers as it is the type of series which continues to be available after the issue date. In fact, this particular disc is an excellent one to start with, as it contains the very popular cantatas "Ach Wie Fluchtig" and "Nun Komm, Der Heiden Heiland". The disc is completed by "Her Gott, Dich Loben Alle Wir".

The singing throughout is of a good standard rather than outstanding, and the whole thing engenders an atmosphere of earnest endeavour, rather than inspiration. Nevertheless, with great music such as this, a competent performance is sufficient to allow the music to speak for itself. I thoroughly enjoyed listening to it, and I am sure most people will be affected the same way, unless they have been influenced already by some favourite performance they already know. The sound is good, and the stereo normal. (H.A.T.)

★ ★ ★

CLASSICAL TOP TEN. Various artists and orchestras. Philips "Universo" series (Phonogram Recordings) stereo 6833 040.

One could perhaps take issue with the person who named this disc about the accuracy of the title, but nevertheless it does contain an attractive selection of classical tunes played by top artists and orchestra, including the English Chamber Orchestra, London Symphony Orchestra, Lamoureux Concert Orchestra and the Concertgebouw Orchestra.

The tunes are: Symphony No 40, first movement (Mozart) — Air on the G String (Bach) — Baderinie from Suite No 2 (Bach) — Finale from Serenade for Wind Instruments (Dvorak) — Symphony No 9, excerpt from Finale (Beethoven) — Sabre Dance (Khatchaturian) — Concerto de Aranjuez, Adagio (Rodrigo) — Prelude in C sharp minor (Rachmaninov) — Adagio in G minor (Albinoni) — Danse Macabre (Saint-Saens).

The standard of performance is high all through, and the sound is satisfactory. (H.A.T.).

★ ★ ★

THE FOUR SEASONS — Vivaldi. Henryk Szeryng (conductor and soloist) with the English Chamber Orchestra. Philips "Universo" Series (Phonogram Recordings) stereo 6580 002.

There is certainly no shortage of acceptable recordings of this popular work throughout the whole spectrum of retail prices. However, this particular version would be worth attention at any price, featuring as it does such an eminent co-operation of soloist and orchestra. It becomes particularly interesting when released on the Philips medium price "Universo" label.

This is a thoroughly enjoyable performance, splendidly played, and very well recorded. I should, however, point out that Szeryng's strong playing tends to dominate the work to some extent, so that it seems much more like a work for solo violin with orchestral accompaniment than is normal. This has been accentuated by the prominence the recording engineer has given to the solo violin. (H.A.T.).

★ ★ ★

SEMPRINI GOLDEN ALBUM. Semprini and his Orchestra. Studio 2 Stereo (EMI) TWO 358.

Semprini is more of an entertainer than a serious musician, and it happens that his brand of entertainment involves light classical music. Having accepted this, one is able to adjust one's thinking to the value of his discs as entertainment, rather than trying to judge them on their musical merits. Nobody is going to pretend that his version of the Adagio from Beethoven's "Moonlight" Sonata as presented here will appeal to devotees of performers such as Rubinstein, Kempff, Barenboim and Richter. Nevertheless, there is a large body of listeners who enjoy the Semprini recipe of light classics arranged for piano and orchestra. And these folk will appreciate the attractive program Semprini has devised here, comprising: Gold and Silver Waltz (Lehar) — Traumerei (Schumann) — Chanson de Matin (Elgar) — Adagio from "Moonlight" Sonata (Beethoven) — Song of India (Rimsky-Korsakov) — Prelude in C Sharp minor (Rachmaninov)—Sheep May Safely Graze (Bach) — Rustle of Spring (Sinding) — Skaters' Waltz (Waldteufel) — Claire de Lune (Debussy) — La Golondrina — Cradle Song (Brahms) — Meditation (Massenet). Tuneful, undemanding, nicely played, it makes good entertainment for those who do not take their classics too seriously. The Studio 2 sound is good, and the stereo is well spread. (H.A.T.).

★ ★ ★

FOR ALL WE KNOW. Andre Kostelanetz and his orchestra. CBS stereo SBP 233994.

If record buyers bought on titles alone then this disc would be a best-seller because all the titles are currently very popular. But the musical arrangements on the disc are lacklustre and the sound quality is poor, especially for a full price disc. Frankly, there is little to commend it.

For those who are still interested, the tracks are: For All We Know — Put Your

Hand In The Hand — I Don't Know How To Love Him — If — Pieces Of Dreams — Lolita — Bridge Over Troubled Water — Someone Who Cares — I Think Of You — Love's Lines, Angles And Rhymes — Losing My Mind. (L.D.S.).

★ ★ ★

THE GOLDEN AGE OF ENGLISH LUTE. Julian Bream, lute. Stereo, RCA Red Seal Victor LSC-3196.

Before the guitar was introduced into England by the Spaniards in the 16th century, the lute was the stringed instrument commonly used in polite society as an accompaniment for voice, and as a solo instrument. The selections presented here are by some of the best known composers of lute music: Two Almaines (R. Johnson) — Fantasia (J. Johnson) — Walsingham (Cutting) — Mignarda (Dowland) — Almaine (Cutting) — Galliard (Rosseter) — Greensleeves (Cutting) — Galliard (Dowland) — Pavan (Morley) — Carman's Whistle (R. Johnson) — Pavan (Bulman) — Monsieur's Almaine (Batchelar) — Pavan (Holborne) — Battel Galliard (Dowland) — Galliard (Holborne). Played by a performer of the standard of Julian Bream, this makes very pleasant listening. Space will not allow any detailed discussion, but if you like medieval music, I do suggest it is worth your while to ask your retailer to let you hear a track or two.

I suggest any of the pieces by Dowland or Cutting for sampling, and if you thought you knew the "Greensleeves" tune, listen to what Cutting makes of this familiar melody. The quality of the recording is first class, bright, clean and commendably free of tape hiss, which often becomes noticeable in solo recitals. (H.A.T.).

★ ★ ★

MUSICA DA NOITE. Rogero's Brazilian Brass. Astor 4D series stereo SPLP 1371.

Rogero's Brazilian Brass consists of three trumpeters backed by a Latin-American rhythm section. As such they turn out music in a workmanlike manner although their arrangements are not startlingly original. Sound quality is standard and stereo spread is wide and even.

There are twelve tracks, with English and Spanish titles: Morning In The City — A Little Night Music — Knock Three Times — Lost In The Night — Dance Of The Hours — Brasilia 71 — Brazilian Women — Peter And The Wolf — Pushbike Song — Habanera — Rose Garden — Sugar Sugar. (L.D.S.).

★ ★ ★

I LOVE PARIS. The Melachrino Strings and Orchestra, with the Trio Musette de Paris. Stereo RCA Camden CAS-2507.

The familiar sound of the Melachrino strings is supplemented here by the pleasant accordeon sounds of the Trio Musette de Paris, who provide the Continental touch to this collection of popular Parisian songs. The Melachrino Strings perform in their usual competent fashion, and the music has been skilfully arranged by Melachrino himself — and is there anybody who can surpass him in this?

There are only nine tracks on the disc, in line with RCA's apparent policy of reducing the playing time of their LP discs. With less

than 14 minutes playing time on side 1 and a very ungenerous 11½ minutes on side two, one wonders how far they can go with this policy. The tracks are: I Love Paris — April in Paris — La Seine — Song of Moulin Rouge — J'Attendrai — C'est Si Bon — Clopin Clopant — Poor People of Paris — La Mer. The sound quality is of good standard. (H.A.T.)

★ ★ ★

ALL-TIME GUITAR HITS EXOTIC GUITARS. Interfusion stereo SITFL-934446. Distributed by Festival Records Pty Ltd.

Just who the Exotic Guitars are played by is not revealed on the record which originates in the USA but they are a skilful group playing in much the same style as the Ventures. Recording quality and stereo spread are good throughout so you can buy without hesitation.

Twelve tracks are featured: Memphis — Maria Elena — Apache — Wildwood Flower — Rebel Rouser — The Enchanted Sea — Classical Gas — Exotic Guitar Boogie — Sleep Walk — Walk, Don't Run — The James Bond Theme — Raunchy. (L.D.S.)

MY HEART REMINDS ME. Wilbur Kentwell playing the 3-manual Conn Theatre Organ. Stereo, RCA Victor sl-101978.

I haven't responded all that warmly to some of Wilbur Kentwell's recent albums but I have no such reservations about this one. It's a beauty and one that will stand comparison to almost any recording I have ever heard of an electronic organ. In fact, it embodies the big sound and the playing techniques commonly associated with the pipe instruments.

The organ itself is the big 3-manual Theatre Conn, feeding into pipe loudspeakers, as well as the usual fixed and rotating sound-field types. The sound is at the one time full and brilliant — and completely clean.

The generously timed program also will have a lot of appeal, being made up of popular modern themes which have their roots in the classics: Till The End Of Time — Chasing Rainbows, To Love Again, Concerto For Two — The Things I Love — Full Moon and Empty Arms — A Song Of Joy — If You Are But A Dream — Mozart 40 — Our Love, Save Me A Dream, Moon Love, Starry Night — Tristesse — Strange Music — Stranger In Paradise, Baubles, Bangles and Beads, This Is My Beloved — My Reverie — Moonlight Madonna — My Heart Reminds Me.

Full marks to Wilbur Kentwell, to Conn, to producer Ron Wills and to recordist David Woodley-Page. Recommended. (W.N.W.)

THIS IS POURCEL. Franck Pourcel and his orchestra. Columbia stereo SOEX 9867.

Sampler albums are usually, in my opinion, not good buying. But this disc, featuring 14 tracks from Franck Pourcel's albums, is one of the exceptions. For a start, its price of $2.95 puts it ahead. Secondly, the tracks link together to form a cohesive whole. Quality is up to a good standard throughout.

Some of the titles are: Dancing In The Sun — A Man Without Love — Love At First Sight — Abacachi — Summertime — Anitra's Dance — This is My Song — Adelita — Aranjuez Mon Amour. (L.D.S.)

MARIACHI INTERNATIONAL. Ace of Clubs stereo SCLA 7037.

Want some authentic Mexican folk music as background for dining or those quiet drinks on the patio at sunset? Then this is the album for you. Sound quality is good throughout and the price is right at $2.95.

Thirteen tunes are presented: Guadalajara — Cielito Lindo — Cucurrucucu Paloma — El Colas — Cancion Mixteca — Las Mananitas — Jarabe Tapatio — La Negra — La Malaguena — La Raspa — Zacatecas — Las Golondrinas. (L.D.S.)

★ ★ ★

THE CORDOVOX MAGIC OF VALENTINO. HMV Stereo SOELP-9789.

It must be admitted that the title of this disc does not sound very promising. It has connotations of a second-rate accordionist murdering popular tunes. But this is completely, misleading. For a start, the instrument used is not an accordion — it has all the electronics of a 4-channel organ built into it. And Valentino is to the Cordovox (call it what you will) what Liberace is to the piano. He even dresses in the same flamboyant style. He was born in Ireland, is a Bachelor of Music and has toured many countries, including Australia.

Some of the tracks are a little trite. After all, how many musicians would care to dress up "Chopsticks" in the way he has. But most tracks are thoroughly enjoyable. The sound quality is good throughout and the stereo spread is naturally spectacular. At the price of $2.95 it is a bargain.

There are 13 tracks in all, some presented in the form of a medley. Some of the tunes presented are: The Desperados — Love Is Blue — Mexican Whistler — Chihuahua — Harry Lime Theme — A Man Without Love — Yellow Bird. (L.D.S.)

★ ★ ★

REUBERT HAYES PLAYS THE CONN "RHAPSODY" ORGAN. St. Columba's Presbyterian Church, Lane Cove, Sydney. Mono, Parker PR-003.

Reubert Hayes has long been an integral part of the organ scene in the Sydney area. He featured during the heyday of the instrument in theatres, stayed with them during their eclipse and is now identified with R.H. Elvy and the Conn.

The organ featured here is the "Rhapsodie", an instrument somewhere near the middle of the range. The occasion was a recital for a relatively small church group, which turned into a recording session only because a representative of Parker Records set up a single mic and tape recorder.

What you hear, therefore, is a straight, unembellished performance, with no opportunity for re-takes or fancy mixing. I only wish I could do as well in such circumstances!

The track titles: Sons Of The Brave — Excerpts: "Sound Of Music" — Jesu, Joy Of Man's Desiring — Schubert; The Immortal — Intermezzo — Excerpts: "The Student Prince" — Evensong — Mediterranean Melody — La Paloma — Toreador Song — Come Back To Sorrento — Chiribiribin — Oh Marie — O Sole Mio — Funiculi, Funicula.

The quality is clean, a little bass-heavy perhaps but good, considering the spontaneous conditions under which it was made. (From Parker Recordings, 9 Carmel Place, Winston Hills, 2153. Price $5 plus 50c pack and postage). (W.N.W.)

★ ★ ★

CONTEMPORARY AUSTRALIAN SONGS by Bryan Kryger Conway, sung by Doug Owens. Stereo, Festival SFL-934484.

The rising standards of local record productions are reflected in this album, commissioned by "The Australian" newspaper, produced with the assistance of the Australian Performing Rights Society, and manufactured by Festival Records, who presumably were also responsible for

DGG "Festival of Hits" Series

MOZART FESTIVAL OF HITS. Various artists and orchestras. DGG stereo 2538 120.
CHOPIN FESTIVAL OF HITS. Various artists. The London Symphony Orchestra conducted by Claudio Abbado. DGG stereo 2538 121.
TCHAIKOWSKY FESTIVAL OF HITS. Various artists and orchestras. DGG stereo 2538 122.

These new releases in the DGG series of "hits" by famous composers maintain the high standard apparent in the first releases reviewed last month. Once again, the material has been very well selected, it is played only by top ranking artists and orchestras under famous conductors, and the sound quality is generally good. These discs must be regarded as excellent value at the price of $3.98.

Here is what they contain:

MOZART: Symphony No 40, first movement — Piano Concerto No 21 ("Elvira Madigan"), second movement — Serenade for Wind Instruments, last movement — Ave Verum Corpus — Marriage of Figaro, March from Third Act — Piano Concerto No 27, last movement — Eine Kleine Nachtmusik, second movement — Turkish March from Piano Sonata in A — Symphony No 34, last movement — Chorus with Glockenspiel, from "The Magic Flute".

CHOPIN: Military Polonaise — Nocturne in E flat — Waltz in C sharp minor — Mazurka in A minor — Black Key study — Study No 3 ("Tristesse") — Polonaise in A flat — Fantasie Impromptu — Waltz in D flat ("Minute") — Piano Concerto No 1, last movement.

TCHAIKOWSKY: Polonaise from "Eugene Onegin" — Waltz from Serenade for Strings — Marche Slav — Overture, March and Chinese Dance from "The Nutcracker" — Waltz from Symphony No 6 — Pizzicato from Symphony No 4 — Waltz from Symphony No 5 — Waltz from "Eugene Onegin".

The Mozart pieces are all eminently pleasing, but I question the inclusion of sections from major works lasting 70 seconds and 45 seconds, even in a "bits and pieces" disc of this type. Against this, one can set the relatively generous playing time required by the inclusion of several long complete movements on both sides of the disc.

The Chopin disc provides an excellent example of contrast in styles. On the one hand there is the heavily romanticised style of Tamas Vasary, replete with wide rubatos and drastic tempo changes; on the other hand there is the penetrating, clearcut style of the brilliant young German pianist Martha Argerich. There is also a very dull performance of the "Military" Polonaise by the usually much more interesting Shura Cherkasky.

The Tchaikowsky disc is particularly generous in playing time, and although one could question the inclusion of some items against the omission of others (nothing from "Swan Lake" ! ! !) the playing throughout is very satisfactory.

Currently available DGG recordings containing full performances of the works represented in these selections are listed in the cover notes in each instance. (H.A.T.)

TRANSISTOR STEREO AMPLIFIERS WITH IN-BUILT AM TUNER
ULTIMATE IN DESIGN — LONG DEPENDABILITY

USING ALL SILICON TRANSISTORS 40 WATTS — RMS

SPECIFICATIONS:
20 watts per channel RMS.
Total output 40 watts RMS.
FREQUENCY RESPONSE:
From 20 to 20,000Hz ± 1dB.
HARMONIC DISTORTION:
Less than 1 per cent of rated output.
HUM AND NOISE:
Aux 70dB, Mag 50dB.
INPUT SENSITIVITY:
Mag 3mV, Aux 200mV.
SPEAKER IMPEDANCE: 8 ohms.
EQUALISED: Mag RIAA.
TONE CONTROLS: Bass, 50Hz ± 12dB; Treble, 10KHz ± 12dB.
LOUDNESS CONTROL: 50Hz 10dB.
SCRATCH FILTER:
(High filter) at 10KHz 9dB.
RUMBLE FILTER:
(Low filter) at 50Hz 5dB.
PROVISION FOR TAPE RECORDER: Record or playback with DIN plug connection.
PROVISION FOR HEADPHONES: With headphone / speaker switch on front panel.
DIMENSIONS: 16½ x 5½ x 11in deep.
TUNER: This unit can be supplied with either valve or transistor tuner with a coverage of 530 to 1600 KHz. Calibrated dial available for all states.
THE CIRCUIT incorporates regulated power supply with transistor switching protection for output transistors. 26 silicon transistors plus 5 diodes are used.

$134.00
PLUS FREIGHT
(CABINET EXTRA)

MODEL C300 / 20 / T
(with Tuner)

$108.00
PLUS FREIGHT
(CABINET EXTRA)

AMPLIFIER ONLY.
Specifications as above but with the added feature of front panel switch which allows selection of two speaker systems.

MODEL C400 / 20

Cabinets for above in teak or walnut with metal trim, $10 extra.

THE NEW MAGNAVOX 8-30 SPEAKER SYSTEM

Complete System (1.6 cubic ft.) in Walnut or Teak Veneer, Oiled Finish. (regret no mail orders for complete system.) —— **$60.00**
Speaker Kit (less cabinets) COMPRISING 1-8 / 30 Speaker, 2-3TC Tweeters, 1-3in. Tube, 1-4 or 2uF Condenser, Innerbond and Speaker Silk Available in 8 or 15 ohms. Postage $1.50 extra. **$29.50.**
Cabinet kits for above 1.6 cu. ft. **$20** each plus freight

NEW 6 WATT STEREO AMPLIFIER WITH A.M. TUNER

$88.00
FREIGHT & PACKING EXTRA
N.S.W. $1.75
Interstate $2.75.
Dimensions 12½" x 3½" x 9" deep

A high quality stereo amplifier incorporating the new Plessey SL403D I.C. audio amplifiers with separate bass and treble controls with inbuilt high gain A.M. tuner giving a coverage of 530 to 1600KHz with calibrated dial available for all States. Timber cabinet available in teak or walnut oiled finish.

SPECIFICATIONS:
DISTORTION:
Less than 1.5 per cent THD at 1KHz, less than 0.5 per cent at 100mW at 1KHz.
SIGNAL TO NOISE RATIO:
-62dB with respect to 3 watts into 8ohms.
FREQUENCY RESPONSE:
Within 2dB from 20Hz to 100KHz.
TONE CONTROLS:
Bass control 15dB boost or cut at 50Hz, treble control 14dB boost or cut at 10KHz.
INPUT SENSITIVITY:
250mV for all imputs, tape, aux. or phono.
SHORT CIRCUIT PROTECTION.

Above amplifier tuner supplies with two Magnavox 8WRMkV speakers, two 3TC tweeters, 2 4mfd. condensers and Garrard SRP22 record player with Sonatone ceramic cartridge.
Details of speaker cabinet with innerbond and speaker silk supplied. **$138.00** ***FREIGHT EXTRA***

TRANSISTOR AM TUNER WITH PREAMPLIFIER

Suitable for use with all valve or transistor Hi-Fi amplifiers, tape recorders or PA amplifiers

SPECIFICATIONS

Frequency coverage 530 to 1600KHz, bandwith 9KHz. Inbuilt aerial, provision for external aerial. 240V AC operation. Dimensions 10¾ x 6 x 3½ins. Output variable from 50mV to 700mV.

$49.00

Post and packing $1.50

CLASSIC RADIO

245 PARRAMATTA ROAD, HABERFIELD, 2045 N.S.W. PHONE 798 7145

the high-quality recording. The disc comes packaged in a lavishly produced folding sleeve adorned with paintings by John Darbyshire of old gold towns of Victoria.

The music is country and western orientated, and could have come from the studios of Nashville — except towards the end of side 2, where something definitely of Australian character is discernible. However, there is no doubting the Australian character of the lyrics, which are mostly more interesting and have greater character than the tunes. I think this can be discerned from the titles: 'Til the Walls Came Tumbling Down — Yellow River Yarra — Wayback — Farewell — Riverine — Menindee Wind — I Look for a Valley — Seven Years Ago — Witchety Witchety — Native Companion — Inverell. My suggestion is — give this disc a try. Ask your retailer to let you hear a few tracks. I think you will like what you hear. Try "Witchety Witchety", which with its did-jeridoo accompaniment and aboriginal terms should appeal to those becoming a little tired of the commercialised C & W material of Nashville. (H.A.T.)

★ ★ ★

HOLIDAY IN ITALY. La Banda del Mandolino conducted by Norrie Paramor. Polydor stereo 2371 219.

Some albums are certainly very well named and this is one of them. The music has an idyllic Neapolitan charm that quickly puts you in a carefree mood. In terms of sound quality, I found the mandolins a trifle overbright but this is easily corrected by the tone controls. Surface noise on my pressing was low. Stereo spread was even and wide.

There are twelve tracks in all: Chiribiribin — Come Back To Sorrento — The Magic Of Loving — Don't Let Tonight Ever End — Everyday A Little Older — Catari catari — O Sole Mio — Help Yourself — A Man Without Love — Santa Lucia — Love Me Tonight — Arrividerci Roma. (L.D.S.)

★ ★ ★

LOVE BOOK. The Lettermen. Capitol stereo ST 836.

The Lettermen are a male vocal trio with rather ordinary voices but they have an ability to harmonise and to inject just the right amount of feeling into their songs. Any more and it would be maudlin. As such, the album forms just the right background for a romantic evening.

The instrumental arrangements are very appropriate and the sound quality is good. If you like the Lettermen, you can buy without hesitation.

Titles on the disc include: Love — Wedding Song — Theme from "Love Story" — How Can You Mend A Broken Heart — Aint No Sunshine — I'm Leavin' — Don't Pull Your Love. (L.D.S.)

★ ★ ★

THE INCOMPARABLE EDITH PIAF. Stereo, RCA Camden CAS 2570.

Since Edith Piaf's career continued well into the LP period, and even into the stereo era, she must presumably have made records for LP and perhaps stereo masters. However, these tracks seem to be remastered from 78rpm discs, and some of them sound quite old, with poor quality sound and background noise. Despite this, the disc is certain to be eagerly sought by those who fell under Piaf's spell, especially at the Camden price of $2.75.

She sings the following ten songs: Amour du Mois de Mai — Une Chanson a Trois Temps — Si Tu Partais — Monsieur X — Les Cloches Son — Le Geste — Les Vieux Bateaux — Sophie — Cousu de Fil Blanc — Monsieur Ernest a Reussi.

Do not be taken in by the other titles listed in the credits. This shows the first number as "La Vie en Rose", a Piaf standard, and I feel a great many people will be disappointed to find, after buying the disc, that Edith Piaf does NOT sing it here. It is hummed by a background female choir, during an announcement in French before the artist comes on stage. Three other numbers are treated the same. (H.A.T.)

Also received . . .

The following records have not been played all through, but have been sampled to assess technical quality. Unless otherwise stated, the discs may be assumed to be technically satisfactory.

IT'S A SIN TO TELL A LIE. Slim Whitman. Stereo, United Artists (Festival) SUAL-934363.

Contents: It's a Sin to Tell a Lie — Follow It — You, You, You — One For You — Sunshine — Near You — The Loveliest Night — Something Beautiful — That's Enough For Me — It Takes a Lot of Tenderness — Redwing — Tammy.

KNOCK THREE TIMES AND MORE. The City of Westminster String Band. Stereo, Astor SPLP 1381.

Contents: Never Ending Song of Love — It's Too Late — What Are You Doing on Sunday — I'm Still Waiting — Say One Word — Me and You and a Dog Named Boo — You've Got a Friend — Knock Three Times — Oh You Pretty Thing — Are We To Blame — How Can You Mend a Broken Heart — Co Co

THE WORLD'S MOST BEAUTIFUL LOVE THEMES. Bob Ralston, piano, with orchestra. Stereo, Calendar (Festival) SR66-9887.

Contents: Theme from "Love Story" — Close to You — If I Loved You — A Time for Us — We Loved by Starlight — Don't Take Your Love From ME — I Was Born In Love With You — Love is Here to Stay — Ann Affair to Remember — Love Theme from "La Strade" — Story of Three Loves — Our Love.

SIXTEEN GREAT PERFORMANCES. Tony Mottola. Stereo, Probe (EMI) SPSS 9875.

Contents include: Satisfaction — Vaya Con Dios — Brasilia — Skip to My Lou — Arriverderci Roma — Carnival Time — Yesterday — Am I Blue — Tenderly — Tijuana Taxi — Volare.

WARM FEELINGS. Tony Mottola. Stereo, Project 3 (Festival) SPJL-934358.

Contents: Make It With You — Tea for Two — Theme from "Love Story" — Watchin' Scotty Grow — For All We Know — It's Too Late — Time and Love — Stardust — It's Impossible — Rainy Days and Mondays — If — Warm Feelings.

GUITAR '72. Al Caiola. Stereo, Interfusion (Festival) SITFL-934292.

Contents: It don't Come Easy — If — Put Your Hand In Mine — Me & You & a Dog

THE NEW ADC-XLM

SUPERB PERFORMANCE
LOWEST MASS
UNBEATABLE PRICE
AND ITS GUARANTEED FOR 10 YEARS

If you're like most audiophiles, you've probably spent a great deal of time, effort and money looking for the "perfect" cartridge.

We know what you've been through. After all, we've been through it ourselves.

That's why we're especially enthusiastic about our newest cartridge, the ADC-XLM. It does everything a well designed cartridge should do. It may not be perfect, but we don't know of any that are better, and few that even come close.

Now, we'd like to tell you why.

The lighter, the better.

To begin with, it is generally agreed that the first consideration in choosing a cartridge should be low mass. And as you may have guessed by now, the LM in our model designation stands for low mass.

Not only is the overall weight of the ADC XLM extremely low, but the mass of the all-important moving system (the stylus assembly) is lower than that of any other cartridge.

Translated into performance, this means effortless tracking at lighter pressures with less distortion.

In fact, used in a well designed, low mass tone arm, the XLM will track better at 0.4 gram than most cartridges at one gram or more.

A new solution for an old problem.

One of the thorniest problems confronting a cartridge designer is how to get rid of the high frequency resonances common to all cartridge systems.

Over the years, various remedies have been tried with only moderate success. Often the cure was worse than the disease.

Now thanks to a little bit of original thinking, ADC has come up with a very effective solution to the problem. We use the electromagnetic forces generated within the cartridge itself to damp out these troublesome resonances. We call this self-correcting process, "Controlled Electrodynamic Damping," or C.E.D. for short.

And if it seems a little complicated, just think of C.E.D. as a more effective way of achieving lower distortion and superior tracking, as well as extending frequency response.

Naturally, there's much more to the new ADC-XLM, like our unique induced magnet system, but let's save that for later.

Guaranteed reliability plus.

At ADC we've always felt that reliability was just as important as any technical specification. That's why we now guarantee every ADC-XLM, exclusive of stylus, for a full ten years.

But this unprecedented guarantee involves something more than just an assurance of quality. It is also an expression of our conviction that the performance of this cartridge is so outstanding that it is not likely to be surpassed within the foreseeable future.

And something more.

In addition to the superb ADC-XLM, there is also a new low mass ADC-VLM, which is recommended for use in record players requiring tracking pressures of more than one gram. The cartridge body is identical for both units, and so is the guarantee. Only the stylus assemblies are different. Thus you can start out modestly and move up to the finest and still protect your investment.

And that brings us to the important question of price, which we are happy to say is significantly lower than what you might reasonably expect to pay for the finest. The suggested list price for the incomparable ADC-XLM is $77 and the runner-up ADC-VLM is only $63.

But no matter which low mass ADC you choose, you can be certain that they share the same outstanding characteristics. . . superb tracking, very low distortion and exceptionally smooth and extended frequency response.

IF IT'S BETTER SOUND IT'S.... ADC

Interstate Distributors:—

NSW: Electronic Parts Pty Ltd, 91a York St, Sydney.
SA: The Muses Pty Ltd (Sound Spectrum), 33 Regent Arcade, Adelaide.
Qld: Brisbane Agencies, 72 Wickham St, Valley, Brisbane.
WA: Arena Distributors (Australia) Pty Ltd, 196 Adelaide Tce, Perth.
Victoria, Tasmania & NT: J. H. Reproducers Co.

National Distributors:

J. H. REPRODUCERS CO,

293 HUNTINGDALE RD, CHADSTONE, VIC. 3148.
TELEPHONES: 277-3066, 277-3488.

Named Boo — Bermuda Sand — Jesus Christ Superstar — I Didn't Know How To Love Him — Another Day — Watchin' Scotty Grow — Theme from "Love Story".

Jazz and Rock....

MORNING OF THE EARTH. Film soundtrack. Warner Brothers stereo WS 20004.

The Australian surf was the inspiration for the songs on this album, which is an outstanding contribution to the modern rock scene. The film is unnecessary to enjoyment of the recording.

This stands as a great collection of songs by young writers. G. Wayne Thomas opens the album with "Morning of the Earth" a delicate song linking the sea with creation. There are a number of his songs on the record — "Open Up Your Heart" and "Day Comes" are outstanding.

Brian Cadd captures the mystery of wave motion in "Making It On Your Own" and "Come With Me". He is an outstanding Melbourne writer and performer.

The LP was recorded at TCS, Melbourne by engineer John French. The sound is good. Taman Shud sound suitably heavy with "First Things First", "Bali Waters" and "Sea the Swells". This is one of the few rock records you'll hear with an Australian sound. (G.W.)

★ ★ ★

FLAMING GALAH. Fraternity. RCA stereo SL 102038.

With a strangely discordant opening, this LP moves into a performance of outstanding character. The members formerly belonged to the hard rock outfit, Levi Smith Clefs. In February of last year they left the big smoke and moved into a rural property in the Adelaide hills.

They had developed a number of originals which fit into the country rock scene. Applying the musical language of American folk rock to an Australian environment can't be expected to produce permutations overnight.

We can detect some of the elements of antipodean culture in songs like "Welfare Boogie", "If You Got It" and "Hemming's Farm"; elements such as repetition, a move toward surrealism and a gradual emergence of the solitary voice.

The danger of rustic returns is that the creative artisit may go under before the weight of English music hall tradition which is still the dominant musical influence in the bush. Fraternity's performance on this LP shows that they have retained their objectivity.

John Robinson's "Seasons of Change" is the keynote tune of the album. Numbers written by the group are better than this. John Eyers, Bruce Howe, Bon Scott, John Freeman, Mick Jurd, John Bisset and Sam See are Fraternity. The LP was recorded by Bill Armstrong in Melbourne with engineer John Sayers. (G.W.)

★ ★ ★

FRESH WATER. Alison McCallum. RCA stereo SL 102 036.

A high powered blues performance comes from a young lady who has been referred to as Australia's Janis Joplin.

The production of the album, by Simon Napier Bell, is exceptional. "Superman" comes out particularly well. This is a theme which fascinates Australian composers. There are a number of tunes around using this idea and all of them are outstanding.

"Ain't Eatin' Dinner Tonight" has the abrasive edge of a jazz performance about it. Alison bites out the lyrics in an exciting performance. The backing musicians, not named, sound like some of Australia's best hot players.

She takes "Any Way You Want Me" at a more thoughtful pace, building up to a crescendo in the closing choruses.

I don't like the device of fading the ride-out endings of some of the tracks. It's a throwback to the days of the 78s when the performance had to end though the band played on. (G.W.)

★ ★ ★

CHILDHOOD'S END. Phil Sawyer. Sweet Peach stereo SPB 505.

As an example of Adelaide cool, this album will take some beating. It features the original compositions of Phil Sawyer sung against some excellent backings arranged by Phil Cuneen. Earlier Sweet Peach albums have been noted for the professionalism of the backings and this one is also in world class.

Sawyer has appeared on a number of LPs from Adelaide. His songs are sensitive and imaginative. "Childhood's End" "Electric Children" and "The Chase" are interesting poems set to music. "Where Did Everybody Go?" is an ironic piece, part political, in the Bob Dylan tradition.

Stan Lewandowski was responsible for engineering on "Electric Children". I won't try to guess how the sounds were produced. (G.W.)

★ ★ ★

HISTORICAL FIGURES AND ANCIENT HEADS. Canned Heat. United Artisits stereo SUAL 934483.

This rock group is one of the best American contemporary outfits playing the blues. For this session they invited a number of guests. The most outstanding was Little Richard who performs outrageously on "Rocking with the King", King Richard, of course. Richard joins Bob Hite for the vocal.

Flute player Charles Lloyd plays on "I Don't Care What You Tell Me" and Harvey Mandel is guest guitarist for "That's All Right".

The blues of Canned Heat are happy and extroverted, enjoyable to listen to, professionally played with musical values as the first consideration. (G.W.)

★ ★ ★

EXCLUSIVELY FOR MY FRIENDS. Oscar Peterson. MPS stereo 15 181.

This intriguing album was recorded in Villingen, Germany in the private recording studio of Hans Georg Brunner-Schwer. It is no ordinary studio.

Brunner-Schwer was formerly co-owner of Saba and is now the owner of MPS which took over Saba. The fidelity of the sound is astonishing. Peterson, who plays so well with a rhythm section, is a superb soloist.

The album opens with a performance of Gershwin's "Someone to Watch Over Me", played as a tribute to the descending runs and fantasies of Art Tatum, a pianist to whom Peterson acknowledges a tremendous debt. "I Should Care" on the other hand, displays many of the devices which are particularly Peterson.

The concert is one of jazz standards, delightful examples of form which are the natural materials of jazz. (G.W.)

PRODUCT REVIEWS AND RELEASES

Cassette deck has glass crystal ferrite heads

The Akai GXC-40D was submitted by Akai Australia Pty Ltd. Notable features are; a glass-crystal ferrite head, an overload protection circuit and the means to increase AC bias amplitude for chromium dioxide tapes.

The Akai GXC-40D has an attractive appearance. Overall dimensions are 16(w)x 4-7/8(h) x 8-5/8(d) inches (412 x 122 x 222 mm) including knobs and feet. The cabinet is teak veneered plywood, while the base and panel are formed from moulded plastic.

Three pushbutton switches are used for power, pause and eject. Two slide pots calibrated 0 to 10 allow recording levels to be set separately for each channel with the aid of two level meters calibrated -20VU to +6VU. In our opinion, these meters are rather difficult to read unless viewed closely.

A toggle switch situated directly above the eject button switches in an overload protection circuit. We tested this circuit by recording a 1kHz sinewave while increasing the input; the maximum VU reading was +3 and no clipping was apparent on playback, although the input was increased to 10 volts. It may be noted that the input sensitivity for zero VU was 48mV, which gave an output off normal tape of 1.1 volts.

Situated to the right of the overload switch is a bias switch which increases the record bias and erase current when chromium dioxide tape is being used. Behind the cassette well is a resettable 3 digit counter, which we found was fairly accurate; cueing was no problem. A two step tape release mechanism allows the unit to be operated while the tape well lid is open. The cassette will eject during all modes except record and play.

Functional facilities also available at the front of the panel include a stereo phone jack and microphone jack for each channel, while at the back of the unit we find (left to right) a screw-in fuse holder cum voltage selector, four phono sockets (two input and two output) and a 5-pin DIN socket which takes care of input and output for both channels. Also supplied is a 3ft connector cable with a five pin DIN plug on one end and four phono plugs on the other.

The tape transport operates very smoothly and can only be heard on rewind and fast forward modes. Mode switching is interlocked, in fact one may switch modes (not including record) at any desired rate without any problem.

A feature mentioned earlier is the glass crystal ferrite head. This head has a crystal ferrite core instead of the usual permalloy type and the whole assembly is encased in glass before the shield is added. This construction is claimed to increase service life, improve sensitivity due to a shallower gap and eliminate the build up of dust and residue in the gap.

The first test we ran with this unit was frequency response. Akai do not quote a reference input level for their test so we assumed the usual level of -20VU. For this test the record level control was maintained at maximum while recording. We ran this test with both normal and chromium dioxide tape; in each case we were able to verify Akai's results.

Akai quote, and we verified for normal tape, response from 30Hz to 16kHz (±3dB), and on chromium dioxide tape from 30Hz to 18kHz (± 3dB). We found with both types of tape, that response from 25Hz to 8kHz was relatively flat while between 9kHz and 15kHz a small peak occurred.

The signal to noise ratio varied for each type of tape. With normal tape we measured 43 dB while the figure for chromium dioxide tape surprisingly deteriorated to 36dB, which would indicate that either the record bias amplitude on this particular unit was not set to the optimum level for chromium dioxide tape or the unit was faulty. Akai quote S to N as better than 45dB, but give no reference to tape used or recording level. Our reference recording level for this test was zero VU.

No figures were given for crosstalk. We measured crosstalk at 100Hz, 1kHz and 10kHz with reference zero VU recording input; the results for normal tape were -31dB, -32dB and -23dB (as frequency increases). With chromium dioxide tape the results improved to -36dB, -32dB, and -27dB. Total distortion measured (1kHz 0VU) was 2% with normal tape and 3% with chromium, again highlighting that bias problem. Akai state less than 2% with no reference to tape used.

We recorded some familiar discs on normal tape and compared the results audibly. Our impression was that the recorded music had slightly accentuated highs and slightly more obvious hiss. When we applied the same comparison to music recorded on chromium dioxide tape the overall frequency response appeared to remain flat but the hiss was still obvious, as one would expect from the test results.

Overall the GXC-40D performs well and meets the majority of the manufactuers specifications. The unit performs well with normal tape but with the present unit it would not really be fair at this time (due to the problems mentioned) to comment on performance with chromium tape. The suggested retail price of $279 places this unit in a price range where machines having Dolby systems are available.

The Akai GXC-40D is now available in Australia from selected retailers and is distributed by Akai Australia Pty Ltd, 276 Castlereagh Street, Sydney, NSW, 2000. (G.N.).

Neat & compact power supply

New lab-type power supply is neat, compact and fully stabilised. Ten turn voltage and current controls allow precision adjustment over ranges 0 to 25 volts and 0 to 1 amp.

The Scientific Electronics 512A supply comes in a compact case finished in satin black, while the front panel which is a continuation of the base is silver anodised. Overall dimensions are 6⅛ (w) x 9⅜ (d) x 4½ (h) inches, or 146 x 238 x 115mm. The unit has minimum controls, namely two ten turn pots for voltage and current levels, together with a slide switch which allows one to monitor either voltage or current using the single panel meter. However these appear to be quite ample.

Three output terminals are provided, namely positive, negative and ground. The positive and negative terminals are fully floating, thus any voltage source up to 300 volts can be connected between ground and the positive or negative terminals.

The meter has a face measuring 2½ x 1½ inches. The voltage range is calibrated from 0 to 25 volts in 5 volt steps, with fine scale markings every volt. The current range is calibrated from 0 to 1 amp in 0.2 amp steps, with fine scale markings every 50 mA. We found the meter calibration at all levels to well within normal limits.

Scientific Electronics quote constant voltage regulation for full load as less than .005%. This was effectively verified as we could not detect any significant voltage variation from zero to maximum load current, using our Solartron LM1619 digital voltmeter. Line regulation is good; we could not detect significant variation in current or voltage levels for mains variations of ±10% (the quoted figure is less than 0.01%). Ripple in the constant voltage mode was under 1mV, less than quoted; in the constant current mode we found it unmeasurably low.

The supply is designed to change from constant voltage to constant current mode in the event of a current overload or output short circuit. When the output voltage / load resistance ratio exceeds the current level setting, the unit thus becomes a constant current source. Quoted load regulation in this mode is less than 0.02% current variation for maximum full load voltage variation. The limit of reading of our instruments again prevented us from verifying this, but the figure was certainly less than 0.5%.

One aspect which we would criticise is the fact that the top of the control panel does not appear to be sufficiently secured; it tends to move slightly when one adjusts the controls. Apart from this the 512A is a sound unit and meets all of the specifications given.

Price of the supply can be obtained on application to Scientific Electronics, 42 Barry Street, Bayswater, Victoria, 3153, or selected dealers. (G.N.).

DC-DC converter operates from car lighter socket

New on the battery eliminator scene is a DC-DC car converter from A & R Electronic Equipment Pty Ltd, intended as a secondary supply source for cassette recorders, transistor radios and the like. It should fill a need for those who require a quick and easy way of reducing battery costs when operating such equipment in a motor vehicle.

The converter consists of a simple transistor / zener regulator circuit housed in a cylindrical plastic body. The end of the body forms the necessary plug for insertion in a conventional auto cigar lighter outlet. Two output voltage levels are selectable by a small slide switch, 6 or 9 volts from a 12 volt input.

The regulator is assembled with the selector switch on a small printed board which fits neatly inside the large section of the converter body. A length of miniature "figure 8" flex about 1½yds (1.3m) long carries the output of the converter to a small coaxial connector having its outer sleeve positive.

Although the converter is supplied as a 12 volt negative ground unit with the output connector sleeve as positive, there is no difficulty in opening the unit to make changes to either the input and / or output polarities as required.

Specifications: Input: 12V DC. Negative chassis system. Output: 6 or 9 volts DC at 300mA maximum. Suggested retail price: $5.99; Trade: $3.45, plus 27½% sales tax. Available from A & R Soanar Group 30-32 Lexton Road, Box Hill, Victoria 3128, or any of their distributors. (G.F.H).

NEW SONY TAPE RECORDER

TC-440 has rotating heads, auto reverse

A rotating head block for bidirectional recording, dual capstan closed-loop tape drive and auto reverse are some of the features which enhance the Sony TC-440. This unit was submitted for review by Jacoby Kempthorne.

The Sony TC-440 is an eye catcher. White borders surround all control notations, giving a projective appearance. Overall dimensions are as follows: 16 (w) x 15¾ (d) x 8 (h) inches including feet and knobs.

Facilities include two miniature microphone jacks, a stereo phone jack, and a potentiometer for sound on sound and echo level controls, used in conjunction with a sound on sound-off-echo function slide switch. There is a tape select switch, which allows a choice of record and erase bias for either normal or low noise tape.

There are individual VU meters for the left and right channels. These meters are easy to read, they are well illuminated and calibration (-20 to +3 VU) is accurate.

Three tape speeds are provided, namely 7½, 3¾ and 1⅞ ips. There is a four digit resetable counter which we found relatively accurate. The motor in this unit is a hysteresis synchronous type.

Of the three features mentioned in the introduction, many readers will be familiar with auto reverse techniques and dual capstans, but the roto-bilateral head assembly incorporated in this unit is original. Briefly this assembly has two heads mounted side by side in a block which is mounted on a horizontal shaft rotating in a bearing. The shaft is hollow and carries the leads to the heads. The assembly rotates 180° mechanically via a cog attached to the end of the hollow shaft when the play key is pressed. Should the tape play right through, the auto reverse mechanism acts (if the tape has a metal leader) and the head assembly is released to rotate back to the original position.

Fast forward and rewind time for 1200 feet of tape was 100 seconds. This unit has an end of tape auto stop mechanism and will not operate without tape. Sony quote frequency response with normal tape at 7½ ips from 30Hz to 20kHz (−3dB) and our figures verified this; however the quoted response at 3¾ and 1-7/8 ips of 20 to 17kHz and 30 to 9kHz respectively could only be obtained if the amplitude limits were extended to ±4dB in each case. Our reference input for these tests was-20VU.

Our figure for signal to noise ratio with normal tape at 7½ ips was 53dB which is exactly what Sony state. We measured crosstalk at 100Hz, 1kHz and 10kHz with normal tape at 7½ ips and reference input zero VU with the following results: (as frequency increases) -40dB, -41dB and -37dB. Finally we measured distortion at each speed off normal tape (1kHz zero VU) and obtained the following figures: at 7½ ips 1.5%, at 3¾ ips 1.5% and at 1-7/8 ips 2%.

Before concluding we recorded some music tracks and compared the playback with that off disc. At 7½ ips there was no discernable difference. At 3¾ ips the response remained flat but hiss was just noticeable, while there were less highs and slightly more hiss at 1-7/8 ips.

In short, our tests show that the Sony TC-440 does do what the manufacturer claims. It is an attractive unit and should have considerable appeal for those seeking a high quality auto-reversing reel-to-reel machine. For $525 (suggested retail price) one gets the deck, two five foot leads with phono plugs on each end, a manual, auto reverse sensing foil and three head cleaners.

The TC-440 is available from selected dealers and is distributed by Jacoby Kempthorne, 469-475 Kent Street, Sydney, NSW 2000. (G-N.).

★ ★ ★

New hybrid IC amps

STANDARD TELEPHONES AND CABLES PTY LTD, Moorebank Ave, Liverpool, NSW 2170, has a new range of low-cost bybrid IC audio amplifiers, with outputs ranging from 3W to 25W, and suitable for 8 ohm or 4 ohm loudspeaker loads. STC has also designed preamplifiers and power supplies for use with these amplifiers. Data sheets are available on application. (See also the PA amplifier project elsewhere in this issue.)

COMPACT RADIO TELEPHONE

A new executive radiotelephone which combines efficiency with elegance has been introduced by Weston Electronics Pty Ltd. It exceeds all PMG requirements for 30kHz channelling.

The Weston 551 VHF FM radiotelephone is a compact, attractively designed unit in a stylish lightweight vinyl-clad cabinet. It is an FM transceiver designed for installation in motor vehicles or other mobile situations, and operates on fixed crystal-controlled channels in the 70-85MHz, 92-94MHz, or 148-174MHz bands. Used with a 240V regulated power supply, it may also act as a base station.

The equipment is all solid state, and incorporates ICs and a protected dual gate MOSFET receiver front end. The transmitter is capable of sustained operation at 25W full output, and the devices used are protected against antenna shorts or open circuits. Separate oscillators are used for each receive channel, and both transmitter and receiver oscillators are trimmer-adjustable for frequency netting purposes. Electronic switching is featured for remote channel selection.

All power input circuits are floating, and either side may be externally earthed if desired. The set is completely guarded against accidental reverse polarity connections. An internal regulated power supply is provided for critical circuits.

Construction is completely modular with plug-in printed boards being used for both RF and DC circuitry. This building-block construction simplifies the provision of remote operation or the adaption of the equipment for specialised requirements such as dual receivers and 20-channel operation. Options available include selective call, mute controlled operation of external equipment, remote operation, and talk-though repeater capability.

Full technical details are available from Weston Electronics Pty Ltd, 376 Eastern Valley Way, Roseville, NSW 2069.

GE METAL OXIDE VARISTORS

A range of metal oxide varistors (MOVs) to eliminate or reduce voltage transients is now available through Australian General Electric Pty Ltd.

Developed in the USA by General Electric Co, these devices are voltage dependent, symmetrical resistors which perform in a manner similar to back-to-back zener diodes in circuit protective functions, and offer advantages in performance and economics.

The varistor impedance at voltages below normal is very high, but when exposed to high energy voltage transients, the impedance changes to a very low conducting value. The dangerous energy of the high voltage pulse is absorbed by the varistor, thus protecting any voltage sensitive circuit components.

The instantaneous current through a varistor is proportional to the voltage across it raised to the power alpha. A GE-MOV has an alpha up to 70 with a guaranteed minimum of 25. By comparison, a resistor has an alpha of 1; selenium varistors from 5 to 15; and a power zener diode about 35. The higher the value of alpha, the sharper the transient suppression and the lower the clamping ratio.

Initially, three type VP metal oxide varistors are available in Australia. All devices in the series are rated to a maximum operating temperature of 85°C with the maximum energy derated 3.8%/°C above that temperature. All have a maximum voltage temperature coefficient of —.05%/°C.

The currently available types are VP250A20, VP250A40 and VP420B40. They have the following maximum ratings: RMS input voltage 250V, 250V and 400V respectively; Recurrent peak voltage 354V, 354V and 595V; Energy 20J, 40J and 40J; Average power dissipation 0.6W, 0.9W and 0.9W; Peak current for pulses less than 7us wide 1kA, 1.25kA and 1.25kA.

The main advantage of using GE-MOV varistors is low cost. The initial cost of a typical unit is low, but in addition with proper transient protection semiconductors with lower ratings can be used in the associated circuit, for a further saving of cost.

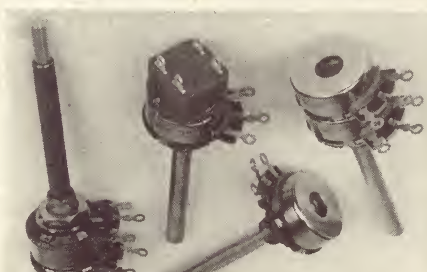
Further details of the type VP metal oxide varistors, including price, may be obtained from Australian General Electric Pty Ltd, 86-90 Bay Street, Ultimo, NSW 2007.

IRH Wirewound Pots

A new range of compact low cost 3W wirewound potentiometers is now available from IRH Components.

The series AW is physically compatible with the CTS series 45, 15 / 16in diameter, commercial carbon pots, and can be combined to make any combination of straight or concentric tandem constructions with or without a switch.

The new series features: high grade resistance element materials for long life reliability; glass filled nylon dust seal; gold plated collector ring for low noise; chemically sealed base material for very high insulation resistance; double contact wiper arm for reliable operation; one piece bush and plate.



The AW series pots are available with resistances

(Continued on Page 105)

The World's Most Versatile Circuit Building System!

SIZES: 1/8" and 1/16" WIDTHS

Length: 100 ft. roll, 5 ft. card

IDEAL FOR PROTOTYPE AND PRODUCTION CONSTRUCTION

USEFUL FOR WIRING REPAIRS

- **NO DRILLING**
- **FAST**
- **NO MESS**

Available from all Leading Radio Houses

Marketed by—

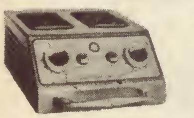
ZEPHYR PRODUCTS PTY. LTD.

70 BATESFORD RD., CHADSTONE, VIC., 3148
Telephone 56-7231

ZEPHYR

Manufacturers of Radio and Electrical Equipment and Components

---



New All Silicon 30/60W PA PORTABLE AMPLIFIER

12-16V, two inputs, 5mV and 100mV. Dimensions 6½in W x 3¼in H x 8½in D. 15-ohm output, No 763D, $62. For 125, 250, 500-ohm output, No 763A, $64. For 240V operation $33 extra.
10W PA amplifier similar to above, 4-ohm output, 240V operation, No 729D, $40. **Freight extra.**

CD IGNITION COIL

For EA (Fraser) circuit. Mounted on strong fibreglass printed circuit coded for all other components. Polyester film layer insulation. Connected and tested. For standard distributor, No 787; for photo cell distributor, No 786. **$8 each. Postage 20c each.**

R.C.S. COMPLETE DO-IT-YOURSELF KITS

Peak reception. Low price. No expensive test equipment. Everything fits. 1964 RF Transporta 7.

Complete kit — No 640 $43.50
Portable car radio. Identical to 640 above, plus extra switch and car coil, etc. No. 642 $46.00
Postage $1.
(Write for booklet on 640 and 642.)

NEW TRANSISTOR PREAMP KIT

SIZE 3 x 2 x 1in, 2 req. for stereo.

LOW IMP input, 2 trans, 672C	$6.50
Wired ready for use, 672D	$8.00
HIGH IMP, 2 trans, 680C	$6.50
Wired ready for use, 680D	$8.00
HIGH IMP silicon, 3 trans, 682C	$8.00
Wired ready for use, 682D	$9.50

Postage 10c each. Write for data.

COILS and IFs 455KHz

Aerial, RF, Osc and IFs	$2.00
Ferrite aerial	$2.40
No. 265 Universal tape Osc coil	$6.00

Postage 10c. Write for details and price.

HI-FI BROADCAST TUNER UNIT
4 TRANSISTORS—HIGH SENSITIVITY

RF mixer, IF, power detector stages, adjustable aerial coupling. Complete as illust, wired and tested with 461 dial, knobs and switch pot, No. 474D, $31. **Freight extra.**
WHISTLE FILTER for above set for 8KHz bandwidth. (Can be altered to 9, 10 or 11KHz.) No. 128, $4. **Post 10c.**

10W STEREO
MULLARD
10 + 10W RMS

With output transistor PROTECTION. Frequency response 40Hz to 30KHz. Distortion 0.5 per cent. Treble, bass boost, 20dB.

Complete kit of parts, No. 480C	$74.00
Wired and tested, No. 408D	$79.00
Cabinet as illustrated	extra $10.00
Magnetic pickup preamp, No. 762D	extra $11.50
Inbuilt BC tuner with w/filter	extra $35.00

Plus freight. Write for brochure. For special Saturday demo, ring 59 6550.

PRINTED CIRCUITS

Clearly coded for easy assembly. With blueprint parts list. Immediate despatch. Add 20c postage. (Specials to your drawings.) Write for complete list of all printed circuits.

813-ET.011	1.80	831-72.P3	2.00	686-65.P12B	2.50	726-68.A8	2.80
814-71.T12	3.00	832-71.A8	2.50	694-66.R2	2.50	759-70.C1	2.80
815-ET.007	2.30	834-ET.026	2.50	704-67.P2	2.50	776-70.A2	4.00
817-ET.014	2.50	835-72.T3	2.80	707-67.P3	2.50	717-68.P1	3.00
818-ET.017	2.50	767-70.BF08	2.00	708-67.A3	2.50	741-69.P5	3.00
819-ET.018	2.50	777-70.F10	2.00	709-67.P4	2.50	747-69.C10	3.00
820-ET.019	2.50	788-71.D3	2.00	711-67.A4	2.50	746-69.P9	3.00
821-71.C12	4.00	772-70.G7	2.00	723-68.5T	2.50	669-65.T3	3.20
822-ET.022	2.50	663-64.M7	2.50	731-68.M12	2.50	727-68.8T	3.20
823-72.SA1	3.00	579-64.A8	2.50	736-69.5T	2.50	728-68.09	3.20
826-72.T2	4.00	683-64.A9	2.50	750-70-A1	2.50	734-69.01	5.00
827-ET.021	2.50	678-65.09	2.50	756-70.R1	2.50	738-69.S3	5.00
828-ET.023	2.50	679-65.M9	2.50	758-70.P1	2.50	740-69.10CL	5.00
829-72.T2D	2.00	684-65.P10	2.50	778-70.TX2	2.50	742-69.C9	5.00
830-72.R2	2.50	685-65.P12A	2.50	792-ET.003	2.50	748-69.D10	5.00
						754-69.C11	5.00

TRANSFORMER

Tap 6V and 9V at 100mA. Filter capacitors, rectifier, resistor, etc. **$6.50. Post 20c.**

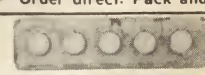
NEW STEREO MAGNETIC PREAMP

Hum free, 5mV input, 250mV out. Size 3 in x 2in x 1in. Wired ready for use. No. 762D. **$11.50. Post 10c.**

NOISE FILTER
for radio and TV

No. 27 line filter, 2A	$8.50
No. 29, 10A. No. 29B, 20A line filter	$35
No. 30 pulse filter, 2A	$11.50
No. 11 aerial filter	$13

Order direct. Pack and post 50c.



MAGNETIC STEREO PRE+AMP

In 5mV, out 250mV. Bass and treble 20dB.

No. 724C	$29
Wired ready for use	$31

Postage 30c each.

For crystal, ceramic, No. 722D	$27

NEW BASS BOOST
4-TRANSISTOR STEREO AMP

Unity Gain:
400Hz, 0dB
100Hz, 5dB
50Hz, 9dB
30Hz, 14dB

Connect between your preamp and main amp. No. 791D, $10.80.
Postage 20c.

779—70.R.D.1	$3.00
780—70.P.A.1	$3.00
790—70.H.P.1	$3.00
783—71.T.U.2	$2.00
766—773—789—71.R.1	$2 ea.
796—71.S.A.4.A	$2.50
	$2.50
798—71.S.A.4.C	$3.00
770—71.A.8	$2.50
812-71.P.8	$2.50

R.C.S. Order by Mail Order. Postal Note or Money Order (add post) direct to —
RADIO PTY. LTD., 651 FOREST ROAD, BEXLEY, N.S.W. 2207. 587 3491

ELECTRONIC CONSTRUCTION KIT

New kitset offers a valuable beginning for intending electronics students and hobbyists.

Before this reviewer examined the Radionic kitset, he expected to find a toy, which would eventually end up all over someone's backyard. However this kitset is not a mere toy. It would appear to be aimed at the 12 to 16 year old market, but no doubt new enthusiasts with many more years behind them would also enjoy constructing and testing some of the 33 interesting and functional projects.

With the kitset comes a 111 page manual. The first 8 pages describe the kit and the function of each component in detail. Half of the remaining literature covers the 33 experiments, with detailed circuit description of each, including such basics as acceptor and donor impurities, electron-hole pairs etc. The remainder of the manual covers "Fundamentals of Electricity".

The main part of the kit is a printed wiring board, with ⅛ inch diameter holes drilled at each connecting point. Each component is mounted on a moulded plastic base with two or more screw studs projecting from the other side for assembly and connection. With the component mounted on the conductor side of the board, 6BA nuts and washers (supplied with the kit) are used to ensure that the component is secured in circuit. No solder or hook up wire is necessary.

Components supplied include: two transistors, a diode, a light dependent resistor, a variable capacitor, a six volt lamp and holder, an earphone, a ferrite rod and MW coil assembly, seven capacitors, seven resistors, a morse key, a length of copper wire (for extra coils) and battery connectors. There is no battery supplied but standard PP4, PP7 or PP9 types are recommended.

The first project we set up was a moisture detector. The two transistors are connected as a Darlington pair and a 40mA lamp was placed in the collector circuit. A piece of blotting paper with two wires threaded approximately half an inch apart along the length was used as a sensor, in series with a 22k resistor connected between the supply rail and the Darlington pair base. A small drop of water between the sensor wires soon spreads sufficiently to initiate base current, and the lamp glows due to collector current.

We also set up a "safety beacon", consisting of a multivibrator with the lamp in one collector circuit. Other projects include: A tuned radio frequency receiver, a morse practise set, a time switch, an electronic violin and 27 others.

We were very impressed by the Radionics X30 Radio and Electronics Kitset, and would recommend it as a suitable beginning for any youngster — or oldie — keen to start in electronics. The kitset is distributed by Ferguson Agencies Pty Ltd, 562 Swanson Street, Carlton, Vic 3053, or 125 Wright Street, Adelaide, SA 5000. (G.N.)

CRC INDUSTRIAL CHEMICALS

CRC Chemicals Australia Pty Ltd announce that they now have a complete range of chemicals for use in engineering, electrical and electronic, automotive, and marine applications. They also provide an advisory service for all sections of industry.

A number of these products are of particular interest to the electrical and electronics industry. CRC 2-26 is a moisture displacer, useful on wiring and windings affected by water or humidity. It also has anti-corrosion, penetrating and lubricating properties.

CRC Lectra-Clean is a heavy duty cleaner and degreaser. It is non-flammable and non-toxic but may be used in most applications previously requiring toxic substances such as carbon tetrachloride.

The company's CO Contact Cleaner is a powerful fluorocarbon solvent which is non-flammable, non-toxic, and safe on almost all materials. Being highly volatile it leaves no residue, and may be used on relay contacts, tape recorder heads and similar delicate components.

Urethane Seal Coat produces a fexible durable film for use on insulators, electrical windings, printed wiring boards, TV feeder cables etc. It is particularly useful out of doors in areas subject to heavy salt or industrial contamination.

Rapid Freeze is a freezer aerosol for rapidly cooling individual components suspected of being temperature sensitive. It is invaluable for quickly locating intermittent faults which may otherwise require hours of costly time to track down.

One of the more recent additions to the CRC range is 3-36. This is generally similar to 2-26, but has been specially compounded for the engineering industry, rather than the electrical industry. As with 2-26 it is a moisture displacer with anti-corrosion, penetrating and lubricating properties.

As already intimated, there is a wide range of other products of interest to mechanical, electrical and marine engineers.

The company's advisory service can make available, in the first instance, detailed technical data sheets describing these products, their uses and manner of application, plus sample aerosols of the selected product. Such requests should be made on company letterhead.

In the event that the problem is a more difficult one the company can provide on the spot technical advice. This service is available in all states.

For further details contact Mr John R. Nicholson, National Sales Manager, CRC Chemicals Australia Pty Ltd, 209 Bulwara Rd., Pyrmont, 2009.

IRH POTS . . . from P. 103

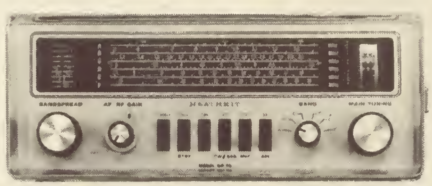
from 1 ohm to 25k, linear law only, with standard tolerance of 10% (special .5%). They are rated at 3W at 25°C derating to no load at 105°C. The voltage rating is 1000V AC for one minute, bushing to terminals, and 500V DC (load not exceeding wattage rating) across end terminals.

Full technical details of the AW series may be obtained from IRH Components Pty Ltd, The Crescent, Kingsgrove, NSW 2208.

TRADE RELEASES — in brief

ELCOMA DIVISION, Philips Industries Ltd, GPO Box 2703, Sydney, 2001. **Polystyrene capacitors**, Micropoco range. These are of extended foil construction with the leads bonded to all foil layers. This virtually eliminates the risk of intermittent faults and results in very low inductance. Current stocks comprise a 125V range supplemented by some values from other voltage ranges. The 125V range encompasses preferred values from 560 to 3900pF. Initial stocks are limited to 5⅜ tolerance types. Operating temperature range is from -40 to +85°C.

SCHLUMBERGER INSTRUMENTATION AUST PTY LTD, PO Box 138, Kew, Vic 3101. Agent for Heath Co, USA. **Heathkit communications receiver**, model GR-78. Frequency coverage: 190 to 410kHz, and 0.55 to 50MHz in five bands. Powered by 9.6V ⅝??MAh nickel-cadmium rechargeable battery, with in-built trickle



charger. All solid-state design including FETs. Modes: AM, CW and SSB. Features: bandspread tuning; automatic noise limiter; relative signal strength meter; receive / standby switch; muting connection; built-in 500Hz crystal calibrator; double superhet on highest frequency range.

MOTOROLA SEMICONDUCTOR PRODUCTS, Suite 204, 37-43 Alexander Street, Crows Nest, NSW 2065. **Zero-voltage switch**, type MFC8070. Designed for zero-voltage gating of triacs, the MFC8070 can be used to drive resistive loads in noise sensitive environments. Features: internal input short or open circuit protection; built-in voltage regulator for operation from AC line; peak output current at least 50mA into 40 ohms; rated power dissipation 1W at 25 C; operating temperature range -10 to +75 C.

A differential input allows two external sensors to be comparet to a reference voltage to generate or inhibit the output gate pulse. Switching threshold is typically within 10mV of the reference voltage. If the differential input capability is used, zero-voltage triac gating applications can be expanded to include hysteresis effects and proportional control.

ROYSTON ELECTRONICS PTY LTD, 22 Firth Street, Doncaster, Vic 3108. Agent for Film Microelectronics Inc, USA. **Input / output hybrid ICs.** Three basic units — to provide analog-to-digital and digital-to-analog interfacing — are available: quad current driver, quad DC interface, and dual level shifter.

At last a breakthrough in the cost for high quality portable radio transceivers of the walkie-talkie hand-held type. We are introducing and offering for sale a fully PMG approved

MIDLAND 1 WATT TRANSCEIVER

for 27,240KHz operation with switch provision for two additional channels, tone call signal, background noise squelch control, battery voltage indicator, steel case with separate cover, good for five miles distance communication under average field conditions, with penlite cell-batteries for

ONLY $39.95 PER UNIT, FULLY GUARANTEED.

A TRANSISTOR PREAMP FOR MAGNETIC PICKUP OR TAPE HEAD

Using 2 transistors per channel, as featured in "Electronics Australia" (Sept. 1971). Complete kit includes transistors, PC board, resistors, capacitors.

Circuit and full details supplied.
Kit (not incl. box) $7.90
240V Power Supply $4.50
Metal box $2.00 extra.
State if required for pickup or tape head.

MAGNAVOX WIDE RANGE TWIN CONE SPEAKERS

8 or 16 ohms VC. Post and Packing 65c.

6WR MK V 12 Watts RMS $9.90
8WR MK V 16 Watts RMS $10.75
10WR MK V 16 Watts RMS $11.50
12WR MK V 16 Watts RMS $12.50

SPEAKER SPECIAL

Imported Tesla 8" Speakers. 8 ohm imp. $4.75. Post and Packing 65c.

NEW LOW COST STEREO SYSTEM

AS FEATURED IN JAN. ELECTRONICS AUSTRALIA

Complete kit of parts including "Garrard" record player with auto. stop and crystal pick-up. Magnavox 8WR or 6WR wide range twin coned speakers. (Cabinets not supplied). Amplifier only, less speakers and player. $32.00

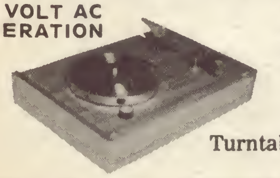
$69.50 Post and packing $2.50 extra.

POLYESTER CAPACITORS

Pack of 100 new polyester capacitors .001 to 0.1 in 160, 250 and 400 volts working. $3.50 Plus 50c Post and Packing

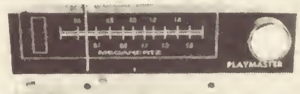
NEW IMPORTED STEREO TURNTABLE AND PICK-UP

240 VOLT AC OPERATION



3 speed turntable with ceramic stereo pickup counter-balanced tubular arm, $7.90. Base in teak or walnut, $5.50 extra. De luxe base $8.50 Post 50c or $1.00 with base. .

Turntable and motor separate . . $4.50



BROADCAST TUNER KIT

$22.50

Post 75c.

Complete kit of parts including dial mechanism and zener diode for this I.C. tuner as featured in Feb. 71 E.A.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, NSW 2048 PHONE 56 7398

KONTAKT Kälte (Cold) **Spray 75** can quickly isolate thermal faults in semi-conductors, condensers, resistances and similar components.

Invaluable for the service technician, **Kontakt 75** is a non toxic, non inflammable and chemically inert coolant spray which can produce temperatures down to −42° Celsius.

Other Uses include:— Prevention of heat damage during soldering.

Location of tiny flaws such as hairline cracks which cause faulty operation when the component becomes heated.

Rapid cooling or freezing of laboratory specimens.

Quick return of heated instruments, etc. to ambient temperatures.

H. ROWE & CO. PTY. LTD. SOLE AUSTRALIAN AGENTS

ADELAIDE BRISBANE HOBART MELBOURNE PERTH SYDNEY

AMATEUR BAND NEWS AND NOTES

by Pierce Healy, VK2APQ

Proposed New Licence Structure

The Wireless Institute of Australia is to seek, from the Postmaster-General's Department, a four class licence structure for the Australian Amateur Service. If approved, it is hoped that it will provide a substantial boost for the amateur ranks.

Featured in these notes from time to time has been the need for a "novice type" licence for the Australian Amateur Service. During the past four years the opinions of many interested persons have been published, including the recommendations of a committee which investigated the subject.

As recently as March, 1972, details of a supplementary report prepared by a WIA committee were published. That report was the basis for discussion at the WIA federal convention in Melbourne over the Easter, 1972, weekend.

Following this, an official statement was made on Sunday morning, 9th April, over all WIA divisional stations. This set out the WIA policy.

"The institute now has a policy of seeking a four class licence structure from the PMG's Department. The old terms 'Full' and 'Limited' licences would disappear under the proposed system and the terms 'Grade A'; 'Grade B'; 'Grade C' and 'Grade D' would replace them.

"Briefly, the different grades would be as follows:—

" 'Grade A' — formerly the AOCP, with all qualifications and privileges as at present.

" 'Grade B' — regulations and theory examinations as for Grade A, with a five word per minute Morse code (CW) test. Operation permitted on all amateur bands 21MHz and above using all modes of transmission permitted for Grade A. The holder of a Grade B licence may convert to Grade A at anytime on passing the 10wpm CW test.

" 'Grade C' — Formerly the AOLCP, but future AOLCP holders would be licensed to operate only on 144MHz and above. Grade C licence holders may convert at any time to Grade A or B by taking the appropriate CW examination.

"Present AOLCP holders would retain their existing privileges.

" 'Grade D' — regulations as for Grades A, B and C, but a lower level theory examination and a 5wpm CW test. Privileges would be; Crystal controlled transmitter, 10 watts input to the final stage and CW mode only. It has been recommended that frequency sub-allocations 21.075MHz to 21.15MHz and 28.1MHz to 28.2MHz be allotted. The licence to have a two year tenure after which time the holder must convert to either Grade A or Grade B or the licence shall lapse.

"These are the recommendations made by Federal Council last weekend. The council also directed that a review of the effect of the 'D Grade' licensing system be carried out after a period of five years from the date of inception."

It was stressed in the broadcast that these were WIA proposals which may or may not be acceptable to the Postmaster-General's Department.

What are the main differences between this policy and the scheme envisaged by the investigating committee? Very little change has been made in what is now termed "Grade D" licence. The differences are:

a. The bands on which operation be permitted has been reduced to two HF bands (21MHz and 28 MH-z) with slight reduction in sub-band limits.
b. The tenure of two years for such a licence. This was suggested in the original report but was amended to no time limit in the supplementary report.

It was envisaged that holders of the AOLCP licence would, on passing a CW test at novice licence standard, be granted the privileges of both. This standard is now termed "Grade B".

The difference between the present AOLCP and "Grade C" is the loss of the 52MHz band by future holders. This change would remove an anomaly, in that International Telecommunication Union regulations require that Morse code be a requirement for amateur licences for the 52MHz band.

There should be little doubt that the proposal will be given favourable consideration by the PMG's Department. It has been publicly stated that: — "the Department would be pleased to examine any fresh proposals relating to novice licences should the institute seek to have the subject submitted for further consideration" ("EA" August, 1971, P83).

A point that should be emphasised concerning the proposed review period is that, besides being a self educational activity, amateur radio is also a self-disciplined activity. In each state a committee of representatives of the amateur service and PMG's Dept officers meet regularly to consider reports concerning breaches of regulations or other matters. Should the proposal be accepted, the activities of those licensed under the new system would be closely observed and where necessary guided towards the correct operating methods and on air behaviour.

QCWA MEETINGS

The Sydney Chapter of the Quarter Century Wireless Association had a change of venue for their meeting on 8th March, 1972. Twelve members met for dinner at the RSL Memorial Club, North Sydney.

On Tuesday evening 14th March, 13 members were guests at an inspection of the Postmaster General's Department monitoring station, Middle Head.

Two officers of the department, Bill Clarke and Chas Hurndell, were the hosts. The station is the standards establishment for radio frequency measurements in the Commonwealth of Australia and comes under the jurisdiction of the Frequency, Regulatory and Licensing; Radio Section; Engineering Division, Postmaster-General's Department.

During the two hour inspection the visitors were given practical demonstrations of the methods used to measure the frequencies of HF and VHF radio transmitting stations in both the commercial and amateur services.

The equipment in service was described and the procedures used were explained. The visitors were very impressed with the accuracy which is achieved and the magnitude of the task of monitoring local and overseas transmissions. It was pointed out that co-operation received from foreign administrations in eliminating interference to various radio channels due either to propagation effects or other factors was of a very high order.

To their hosts for the evening and to Mr Ron Holt of the Radio Branch, Sydney, members who attended express their appreciation for a very informative and educational evening.

Membership of the Sydney Chapter, QCWA, is open to amateur radio operators who have been licensed for 25 years or more. Further information may be obtained from the President, Harry Caldecott, VK2DA; Secretary, Pierce Healy, VK2APQ; Treasurer, Brian Anderson, VK2AND at their call book addresses.

The guest at the April meeting was Ron Holt, VK2QQ, of the Radio Branch PMG's Dept, Sydney. During the informal discussion following dinner, Ron spoke on the work done by the monitoring station and outlined some of the tasks undertaken by the Radio Branch in conjunction with other members of the International Telecommunication Union, Frequency Registration Board (FRB).

Visitors also present at the April meeting were: Ivan Agar, VK2AIM and Al Davis-Rice, VK2AXR.

AMSAT NEWS

Last month's notes mentioned possible delay in launching the A-O-B amateur satellite. Official information has confirmed the delay, caused through some systems falling behind schedule. The AMSAT Board of Directors has decided to prepare a more simplified space craft to meet the launch date in July, 1972. This will be known as A-O-C. Details are:—

Weight — 35 pounds (15.876kg)
Dimensions — 17" X 12" X 6" (43 cm X 30cm X 15cm)
Structure — Non-modular
Power
 Solar panels — 50% of surface
 Voltage — 24 volts
 Battery 6A hr — 18 cell nickel-cadmium
 Average power — 3.5 watts
Telemetry — 24 channel Morse code format
Message storage — 768 bit programmable shift register
Experiment control — 2 modes, ground controlled
Command — 21 pulse commands
Repeaters — 144MHz up 29MHz down, linear, 1-2W pep
Beacons — 29.45MHz (in band beacon within repeater pass band) 0.2 watt (A-1); 435.1MHz 0.35 to 0.45 watts (a-1)

WIRELESS INSTITUTE ACTIVITIES

In addition to licensing, several matters relating to VHF and HF operation were discussed at the WIA Federal Convention during Easter, 1972. These include VHF / UHF band planning, especially in the 144MHz band; repeaters; project Australis; the use of GMT, and WIA contest awards.

It was decided that the Victorian Division would provide the personnel for a federal VHF UHF band planning advisory committee. This committee to work in close co-operation with other federal committees and interested parties.

The repeater committee, provided by the NSW Division since its inception in 1968, was reappointed for a further three years. A recommendation was adopted that no repeater or simplex net channels be set up below 146MHz until agreement has been reached on VHF / UHF band planning.

Regarding contests, charges have been increased for non-WIA member applicants for the following awards:
Australian DXCC
Australian VHFCC
Australian WAS

The VHFCC award has been extended to cover UHF and SHF. Also the WAVKCA now has its counterpart for the VHF bands. GMT will be introduced into the Ross Hull Contest to overcome difficulties caused by daylight saving.

Project Australis was reviewed and additional finance approved. Certain proceedures in relation to the administration were set down.

Howard Rider was appointed WIA special representative in Indonesia. He will be asked to investigate and report on how best the WIA may assist amateur radio in that area.

NEW SOUTH WALES VHF & TV Group

The revised charter of the NSW, VHF-TV Group, approved by the VK2 Division Council late in 1971, was designed to provide a more stable control of the group's activities. The charter now requires that nominations for the management committee be received in writing at least 21 days prior to the annual general meeting. Only six nominations were received and therefore no ballot was necessary. The committee met for the first time on 13th April, 1972, and the following office bearers were elected.

Ian Binnie, VK2ZIU, Chairman and Treasurer.
Grahame Wilson, VK2ZGW, Vice-chairman; Disposals and Social activities.
Mike Farrell, VK2AM, Secretary.
Roger Harrison, VK2ZTB, Public Relations and Newsletter Editor.
Syd Griffith, VK2ZYD, VHF Broadcasts
Stephan Kuhl, VK2ZSK, Committee member.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown, NSW 2200.

Mid-winter Field Day

Dates:
10th, 11th and 12th June, 1972
Duration: 36 Hours
Sections:
1.Single operator stations. Total or six hour periods.
2. Multi-operator or club stations. Total or six hour periods.
Scoring:
One contact per band per station per hour, no contacts allowed through repeaters for scoring purposes.

Points may be gained on the following basis:—
52MHz & 144MHz bands — 1 point per 10 miles or part thereof.
432MHz band — 2 points per 10 miles or part thereof.
Other UHF bands 5 points per 10 miles or part thereof.
Multiplers:
Home station — Home station X 1
Home station — Field / Mobile station X 2
Field Mobile station — Field / Mobile station X 5.

The total band score shall be divided by the DC power input to the final stage of the transmitter.

Net Channels:
Contacts on net channels may claim multiplier points only. No mileage points may be claimed.

Entry forms must be submitted to the secretary, VH-F / TV Group 14 Atchison Street, Crows Nest 2065, by 28th July, 1972.

Plans are in hand for a national VHF — DX contest in August, 1972. This will be on the same lines as the VK8AU contest. (Details in "E.A" May 1971, page 139).

Meetings of the VHF — TV Group are held on the first Friday in each month at Wireless Institute Centre, 14 Atchison Street, Crows Nest, at 8pm. Visitors are welcome.

WIA YOUTH RADIO SCHEME
Maitland Radio Club

The club is now providing six technical classes of instruction for members of all age groups wishing to improve their knowledge in radio and to gain their amateur licence.

Classes held each week include three elementary classes for beginners, one junior, one intermediate, and the AOCP for advanced members. Instructors are Messrs D. Cross, K. Mahon, A. Counsell, J. Gibson, K. Watson.

As the club's major building program is completed the newly elected committee is building up tool kits and electronic projects to promote the practical instruction. The committee has made certain class projects compulsory for the Youth Radio Club Scheme's radio certificate examinations.

The club is located in Maize Street, Tenambit, East Maitland. Details may be obtained from the secretary, PO Box 54, East Maitland 2323, or telephone Maitland 33 7286.

Westlakes Radio Club

The club has now installed its VHF transmitter at its new location, Church of England Hall, Ranclaud Street, Booragul. It will be used as part of the instructional course for the AOCP and AOLCP classes. The tower carrying the VHF antenna, erected at the rear of the building will also be used as support for the inverted "V" aerial for 160 metres. This together with a HF transmitter will be used for instruction.

Details of the club may be obtained from the secretary, Eric Brochbank, VK2ZOP, PO Box 1, Teralba 2284 or telephone Newcastle 58 1588.

St George Amateur Radio Society

The St George YRCS Training Annex continues to attract attention and praise for its audio-visual instructional program.

A students' council has been formed among those studying at the annex, and invited to submit suggestions for further improvements. One suggestion, already being examined by the education officer, Noel Ericsson VK2MF, is the establishment of a Saturday afternoon workshop training program.

A Morse code trainer is now operative and experience has shown that a student can learn to receive the code at three words per minute in six weeks. Stan Clark has joined the construction team which is building an electronic coupling unit which will enable fully automatic presentation of the audio-visual programs.

Details may be obtained from Noel Ericsson, VK2-MF17 McIntyre Avenue, Brighton-le-Sands, 2216 or telephone 59 1658.

To cater for society members who possess a knowledge of fundamental radio theory, Mike McKenzie, VK2BMM and Chris Jones, VK2ZDD have organised an AOCP preparatory class each Tuesday night. To cater for the holders of limited licences and others who can receive Morse code at 5 words per minute, Alf Cutting, VK2AAC and Ivan Brown, VK2RY conduct a training session each Thursday night. For details of venue phone Mike McKenzie, VK2BMM, on 299 2920.

Club meetings are held in the Civil Defence Hall, The Mall, South Hurstville, on the first Wednesday of each month. Visitors welcome.

Springwood Bush Fire Brigade

Training classes for YRCS and AOCP examinations are being conducted in the Springwood district, within the Springwood Bushfire Brigade, under the supervision of Rex Black, VK2YA. Although most of the students are drawn from the Brigade, the classes are open to all.

Five adult members of the Brigade communications group attended the February Amateur Operators Certificate of Proficiency examination conducted at Springwood Civic Centre by the Postmaster from Lawson. At the subsequent "post mortem" it appeared that there could be two or three successful candidates. The official results are awaited with interest. Only two attempted the Morse code test and it seems that they might have to try again at the May Morse code test.

However, it will be possible for them to concentrate on the Morse code without the distraction of studying the theory and regulations. So this year should see several more Full AOCP operators pouring RF into the ether from the Blue Mountains area.

Several adult and school student members of the North Springwood Fire Brigade have already been successful in obtaining their YRCS Elementary Radio Certificates, these are:—

Honours Pass: Bruce Farnsworth, John Oxley, David Noble, Les Begg. Pass Grade: Pat Hanvin.

Meetings of both AOCP and YRCS groups are held in the Fire Tender shed at North Springwood. The "red monster" has to be moved out to make room for the radio students. It is hoped that one day a separate communications centre including an amateur radio station will be available so that supervised operating instructions may be given to the enthusiastic members.

One of the aims of the organisers of the Springwood group is to provide personnel trained in radio communication who would be available in the case of bushfires which can do a great deal of damage in the area.

Central Coast Repeater

To enable users to obtain the most satisfactory performance from the Central Coast repeater the following information has been made available by the repeater committee of the Central Coast Amateur Radio Club. Installed at the club rooms located at Kariong just south of Gosford, New South Wales, the location provides an excellent coverage area, not only for the Gosford area but for many miles to the north and south for those travelling along the Pacific Highway between Sydney and Newcastle.

Operating on Channel 1 under the club's official call sign VK2AFY-R, the repeater was temporarily installed for the Field Day held on 20th February, 1972.

For Channel 1 repeaters the user must transmit on 146.1MHz and receive on 145.6MHz. Crystal frequencies required for the conversion of several types of mobile units available through disposal sources are:

Unit type	Transmit crystal	Receive crystal
AWA	4058.333KHz	10257.143KHz
Pye Ranger	4053.333KHz	13025.0KHz
TCA 1674	4053.333KHz	20514.285KHz
TCA 1675 / 77	4058.333KHz	42948.0KHz
Some STC	6087.5KHz	16600.0KHz

The receiver of the repeater operates continuously but the transmitter is only brought into operation when it is required to be used. If the transmitter is not heard in operation it is necessary to transmit a steady, unbroken, preferably flutter free carrier into the receiver of the repeater for five seconds. Then wait for 40 seconds for the filaments of the valves in the transmitter to heat up.

The repeater call sign will then be transmitted in MCW at 860Hz tone to signify that the repeater is operational. You may now transmit into the repeater, but allow half second for the relays in the repeater to operate before speaking. When you cease to transmit, the repeater will transmit a two second noise burst from the unmuted receiver. The purpose of this two second hold time is to prevent chopping up (multiple keying of the repeater transmitter) on a fluttery signal at the repeater input.

In compliance with the PMG's Department requirements the repeater is equipped with timers which automatically turn the repeater off in the case of a malfunction. But unfortunately the timers cannot identify the difference between a lengthy transmission from a user to a fault condition that may occur. The

first of these timers is concerned with the length of transmission into the repeater.

If a fault condition exists or the length of a single transmission period by a user exceeds four minutes duration, a two second burst of 860Hz tone is superimposed on the repeated audio at low level (15dB below clipping level in the repeater transmitter) to indicate "Time out" and the transmitter is switched into stand-by condition.

The tone burst indicates to the listener that a "time out" has occurred as distinct from a repeater failure or a failure in the transmitting operator's equipment. To prevent "time out", operators should cease transmitting for one second every three minutes to ensure against a "time out". A one second pause should be made between overs. It is not necessary to wait for the completion of the two second noise burst.

The repeater call sign, VK2AFY-R will be automatically transmitted every four to five minutes whilst the repeater is in use. If the repeater is not used for eight minutes, or a signal is transmitted into the repeater continuously for eight minutes (possibly a fault condition), the transmitter power supply will be turned off. If the condition is a continuous carrier or receiver fault, the carrier or fault must clear to allow the repeater to be turned on again. The switch on procedure is as previously indicated.

If the transmitter locks on, ie, remains on after the normal two second noise burst period, the repeater will operate normally whilst it is used as above, with one exception. If a signal is not received at the repeater input for thirty seconds, the transmitter power supply is turned off, but may be turned on as previously described.

Further information may be obtained from members of the repeater committee or by writing with any queries to the chairman,

Central Coast Repeater Committee,
Post office Box 238
Gosford, NSW 2250.

Please include a 9" x 4" stamped self addressed envelope with any inquiry to facilitate the despatch of your reply.

Moonbounce Success

On Wednesday evening, 19th April, 1972, a successful two-way Earth-Moon-Earth contact was made on 432-MHz from Dapto, New South Wales, to Inglewood, California.

The stations were VK2AMW (call sign of the Illawarra Branch, NSW Division WIA) operated by Lyle Patison, VK2ALU, from the Wollongong College Radio Telescope at Dapto and Harley Herndon, WA6HXW in Inglewood. Further tests were scheduled to be made during May.

The story of this combined UHF project, by amateurs in the Illawarra area and the Wollongong College, were given in the May, 1971, issue of these notes.

VICTORIA

Geelong Amateur Radio-TV Club

The April newsletter contained a comprehensive questionnaire inviting suggestions and comments which would assist clubs activities. This should assist the committee to plan activities for the coming year.

Visitors to Geelong are invited to attend club meetings which are held at the Club Rooms, Storrer Street, East Geelong, each Friday night. Contact the secretary, Bob Wookey, VK3IC, PO Box 520, Geelong, Vic 3220 or telephone Geelong 21 2674 for details.

29 DX CLUB
VHF RTTY Net

To encourage and promote interest in RTTY (radio-teletype) those interested are invited to contact the secretary of the 29 DX Club with the view of forming a VHF RTTY net. It is claimed that there are more RTTY operators in Western Australia than in the eastern states. Suggestions should be sent to Alan Gibbs, VK6PG, 12 Munyard Way, Morley, WA 6062.

NEWS FROM INDIA

At a special meeting, the Amateur Radio Society of India and the Radio and Electronics Society of India agreed to resolve their differences and form a unified amateur radio organisation in India. As from 1st January, 1972, a new organisation known as the Radio Amateur Society of India, will endeavour to stimulate the interest of amateur radio throughout the country.

Several changes were introduced due to the merger. All matters relating to the incorporation of the new society will be handled by the Radio and Electronic Society of India. The affairs of the Amateur Radio Society of India were wound up on 31st December, 1971. Likewise the affairs of the Radio and Electronic Society of India will be wound up on 30th June, 1972.

The QSL bureau which operated through PO Box 543, New Delhi was closed down after 29th February, 1972. All QSL cards should now be sent to the Radio and Electronics Society of India, PO Box 6538, Bombay 26, India until further notice. Any QSL cards received at New Delhi after 29th February are sent to Bombay for sorting and distribution.

The publication of the amateur radio magazine, the Indian Radio Amateur, will continue to be circulated from New Delhi.

Membership subscriptions should be sent to the Radio and Electronics Society of India, PO Box 6538, Bombay 26, India until further notice.

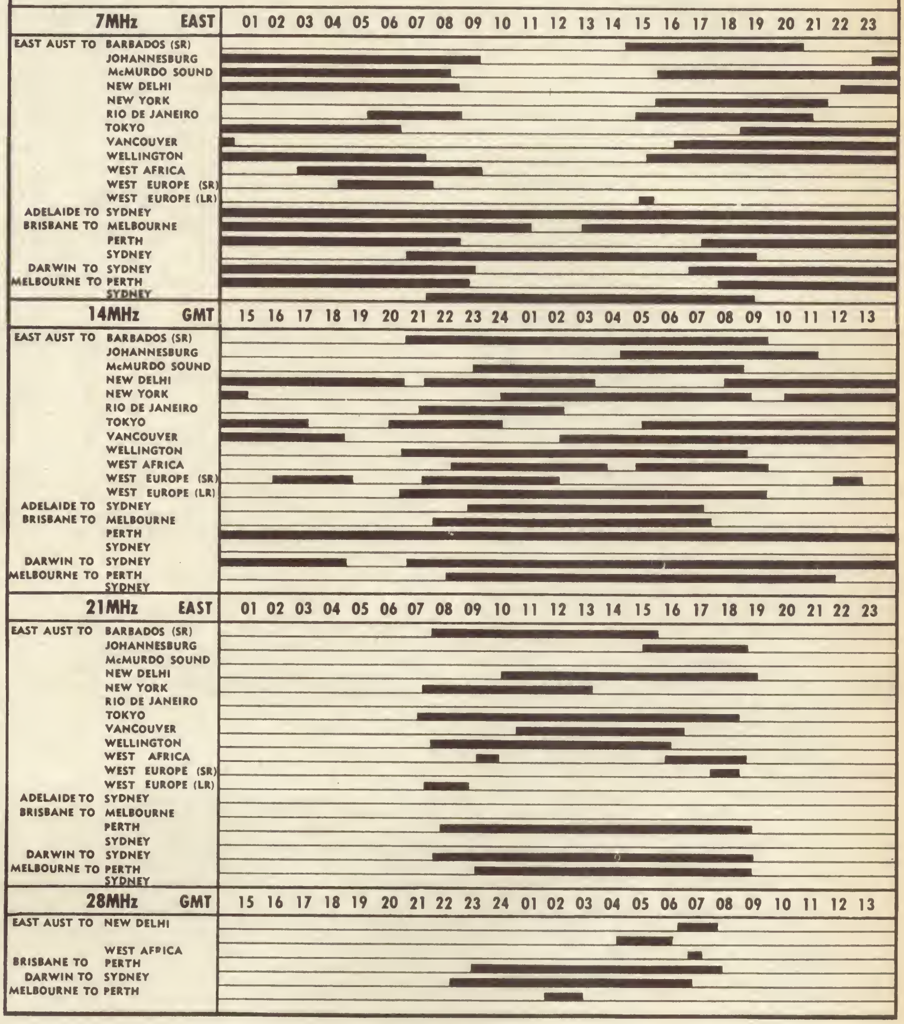
This agreement to re-constitute the official amateur radio society of India is the outcome of a decision made at the First All India Amateur Radio Convention held at Bombay in December, 1969 at which your correspondent was a guest delegate.

Having a first hand knowledge of the problems that existed at the time, it is indeed pleasing for me to learn that a solution has been found. I feel sure that the decision made is a big step in the right direction and will greatly assist the rapidly expanding interest in amateur radio throughout India.

The Indian radio amateur is very much aware of the need for a strong International Amateur Radio Union, Region 111 organisation. It is safe to predict that when the formalities for the transfer of IARU membership to the new society are completed the RASI will be a very active member of the Region 111 Association.

IONOSPHERIC PREDICTIONS FOR JUNE

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Commonwealth Bureau of Meteorology. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). They have been prepared for the four most popular amateur bands over a number of interstate and international circuits. Black bands indicate periods when circuit is open. 6.72



ANSWERS TO CORRESPONDENTS

ACT COMMERCIAL STATION: I would like to know the opening date for the commercial station in Canberra, its name, frequency, power, and the owner. (B.H., Deakin, ACT).

Although we publish the frequencies, power and other information of broadcast and TV stations once a year (usually January), we have no information on projected stations. We suggest that you contact the PMG Radio Branch in your capital city to obtain your information.

TRANSISTOR TESTER: I have built the Transistor and FET Tester described in the August, 1971 issue of "Electronics Australia", but I am not clear how to test an ordinary PNP or NPN transistor. Does the transistor have to be in circuit for a test? I tried a PNP transistor which I know to be good, out of circuit, but there was no reaction from the meter. (S.G., Sydney, NSW.)

The tester is for out-of-circuit checks only. The device is connected to the terminals marked E for emitter, B for base, and C for collector, in the case of ordinary transistors. For FETs, the terminals are marked D for drain, G for gate and S for source. If appropriate readings are not obtained when the controls are manipulated, and the device tested is known to be good, then the tester has a built-in fault which will have to be found and corrected.

COMPLIMENTS: I wish to congratulate you on your five simple transistor projects in January 1972. I built the white noise generator and the impedance matching stage. With the latter inserted between one channel of a stereo system and the input to an electronic organ (using the organ speaker system for one channel), I eliminated a distortion problem, and improved the quality greatly. I am looking for more simple projects like these. Have you ever published a design for a filter system which passes a bass signal only? (N.H., Frankston, Vic.)

We are encouraged to know that the simple projects you mention have proved of value, N.H., and we are glad that you solved you distortion problem with the use of one of them. It appears as though the organ input was creating this distortion due to loading of the signal, and your remedy was quite in order — in fact, we probably would have suggested the same type of stage. We intend to include more simple projects from time to time, so that you should not be disappointed. A filter system which passes bass only has not been described, but the low-pass section of a crossover network can be used if properly terminated in its characteristic impedance. Crossover network designs have been published in the Oct 1955, July 1956, and Dec 1956 issues. Reprints of the above can be obtained through the reprint service for 50c each under File Nos 1/SE/4, 1/SE/5, and 1/SE/7, respectively.

NOISE SUPPRESSOR: I am a 14-year-old high school student and very interested in electronics. Can you help me with answers to the following questions? (1) Is it possible to make a noise suppressor for a tape recorder output or a suppressor for the input (for example, against wind)? (2) What is the formula for series resonance, what is a practical way to measure impedance, and how does one calcualte the values of inductances and capacitances in low-pass and high pass filters for given frequencies? (3) Are there any devices that give voltage or resistance changes when illuminated by ultra-violet light, infrared, or x-rays? (C.C., Turramurra, NSW.)

Taking your questions in order. (1) If you mean is it possible to suppress noise without affecting the signal quality, the answer is — No. The second part of your question is not clear. However, unwanted ambient noise can be minimised by the use of directional microphones, and wind noise by fitting a wind shield. (2) These questions are all part of basic theory, and the answers can be found in just about any good comprehensive basic theory book. (3) Such devices do exist and are used in various industrial, technical and research applications. Articles in "Electronics Australia" often contain reference to devices of this nature and their application.

REVERBERATION: I have been reading your magazine for about five years but have not yet come across any articles on reverberation units. Any information available about these units would be useful. (W.F., Allambie Heights, NSW.)

We refer you to your October, 1967 copy of the magazine where, on page 51, is the start of an article describing a reverberation system. However, if you no longer have this issue of the magazine, a project reprint of the article can be obtained from the Information Service for 50c (File No 1/GA/12).

TELEPHONE AS AERIAL: I have constructed a crystal set using a ferrite rod aerial, and have been using the finger stop on the telephone as an aerial. Using this I can receive the local station fairly loudly. Is there any danger in using the finger stop as an aerial or earth? Also, have you published a circuit for a direct reading capacitance meter, transistor amplifier with high input impedance and 8 ohm speaker, and a transistorised metal detector. (J.L., Hamilton. Vic.)

While we cannot see any objection to using the telephone in this way, there may be something in the PMG regulations which prohibits this. You would be advised to check up on this with the PMG's department in your capital city. In the modern type of telephone, we understand that the finger stop is screwed into plastic, and is not part of the circuit in any way. So you may have been lucky to have enough capacitive coupling to enable the phone to work as an aerial. The latest direct reading capacitance meter we published was the Probe Type Capacitance Meter, March 1971, File No. 7/CM/5. It was for measuring small amounts of capacitance, (up to 50pF). An amplifier of the type you require was one of the "Simple Transistor Amplifier Circuits", described in the March 1970 issue, File No. 1/XA/10; and a metal locator was described in the January 1970 issue, File No. 3/MS/20. Copies of these articles are available for the usual fifty cent fee.

AMATEUR RADIO: Will you please advise me how to become an amateur radio operator. (R.P., Ashfield, NSW.)

The requirements for the operation of an amateur radio station are set out in full in the booklet "Handbook for Operators of Radio Stations in the Amateur Service", available from the Radio Branch, Postmaster-General's Department. 83 Miller Street, North Sydney, NSW 2060. The Wireless Institute of Australia conducts courses of study for anybody, whether members of the Institute or not, who wishes to prepare for the PMG examination which applicants for an amateur licence must pass. Details are available from The Course Supervisor, WIA, 14 Atchison Street, Crows Nest. NSW 2065.

"ELECTRONICS AUSTRALIA" INFORMATION SERVICES

As a service to readers "Electronics Australia" is able to offer: (1) Project reprints metal work dyelines, photographs, printed wiring patterns and other filed material to do with constructional projects and (2) A strictly limited degree of assistance by mail or through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: These cost 50c per project. Prior to December 1959, circuits and diagrams only are available. From December 1959 onwards, complete articles are available. No material can be supplied, additional to that already published. Reprints can be supplied more speedily if they are positively identified and not accompanied by technical queries. Material not on file can normally be supplied in photostat form at 30c per page.

SUBSCRIPTIONS, BINDERS, HANDBOOKS etc: These are handled by seperate departments. For fastest service, send separate orders to the departments concerned.

PHOTOGRAPHS, METAL WORK DRAWINGS: Original photographs are available for most projects. Price: $1 for 6in x 8in glossy print. Metal work dyelines are available for most projects. Price: $1 These show dimensions and positions of holes and cut-outs, but give no wiring details.

PRINTED WIRING PATTERNS: We can supply negative transparencies, actual size. Price: 50c. We do NOT deal in manufactured boards. These are available from advertisers

BACK NUMBERS: As available. On issues up to six months, face value. Seven months to 12 months, face value plus 5c. Thirteen months or older, face value plus 10c. Postage and packing, 10c per issue extra. Please indicate if a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: These are provided to assist readers encountering problems in the construction of our projects published within the last two years. Note, particularly, that we cannot provide lengthy answers, or undertake special research or modifications to basic designs. Charge: 50c. Inclusion of an additional fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee and may be answered in the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

COMMERCIAL EQUIPMENT: "Electronics Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals equipment etc. We are therefore not in a position to comment on any aspect of such equipment.

COMPONENTS: "Electronics Australia" does not deal in electronic components. Prices, specifications etc should be sought from appropriate advertisers or agents.

REMITTANCES: These must be negotiable in Australia. Where the exact charge may be in doubt, we recommend submitting an open cheque, endorsed with a suitable limitation.

POSTAGE & PACKING: All charges shown include postage and packing, unless otherwise specified

ADDRESS: All requests for data and information should be directed to the Assistant Editor, "Electronics Australia", Box 2728, GPO Sydney, NSW, 2001 — (10/71)

IMPEDANCE MATCHING: Can the Impedance Matching Stage published in the Jan 1972 issue in the "Elementary Electronics" section be used for matching the impedance of a crystal mike to that of a dynamic one? (G.C., Bendigo, Vic).

As it stands, the Impedance Matching stage has an input impedance of around 50k, which is too low for a crystal microphone. The input impedance could be raised by using a high-gain transistor such the BC109 with an emitter resistance of 10k, and two base bias resistors of 4.7M each. This will produce an input impedance of approximately 1.5M, assuming a following amplifier input impedance of greater than 20k. 1.5M is still on the low side for a crystal microphone but it may suffice for your purpose.

CONGRATULATIONS: I am a relative beginner in electronics, but have been reading your magazine for over a year. I think it is the best. Congratulations on an excellent layout, selection of articles and variety of projects. I recently constructed the proximity switch but have been unable to buy the specified transformer in any brand. Could you advise me of suppliers of the component. Also, have you ever described a fluoroscope with the associated X-ray apparatus. (E.R., Joondanna, W.A.)

Thank you for the compliments, E.R. The transformer we used in the Proximity Switch was a Ferguson type PF2235. As you live in Western Australia, the Willis Trading Company (who advertise regularly in the magazine) may be able to supply or order the transformer. We have not described any fluoroscope or X-ray apparatus. These devices would be much too dangerous for use by inexperienced people.

DIGITAL EQUIPMENT: I have been a reader of your magazine for ten years and would like to compliment you on the high quality. However, there is one field of electronics you have tended to ignore — that of digital electronics. The last project you did along this line was the 70MHz Digital Frequency Meter in May 1970 — over two years ago. Some US magazines have been very active in this area. I would like to build some digital projects — possibly a digital multimeter and a digital clock. I hope you will consider publishing these in the near future. There are no doubt many more readers who would be interested. (.R.S., Hawthorn, Vic.)

No doubt there would be some readers interested in digital equipment, R.S., but we have reservations as to the number who would build this type of equipment if it were described. It is fair enough to say that US (and other) magazines feature this very regularly — but they are not faced with many of the supply problems which we are in Australia. Perhaps the greatest of these is the cost. We have inflated prices for imported components and, in this particular field, the supply of local components is relatively limited. So anything we make is bound to cost more than a similar device in the US or Europe. Again, there is the problem of appeal. An electronic digital clock may look impressive but, considering the cost, is it really more functional than, say, a "flip-over" type numerical clock which can be obtained for less than twenty dollars? The same comments apply, in many applications, to digital multimeters as against conventional VTVM's.

PENFRIEND WANTED: I am 14 years old and read Electronics Australia every month. I would like a penfriend of my age who is also interested in electronics and SWL. Could you please print my name and address. Also, I would like to build a BFO, and hear from anyone who has a circuit for a Philips 175A receiver. (Wayne Newport, 19 Lookout St, Thirroul, NSW 2515)

As you can see, we have printed your name as requested. Our latest BFO was described in the September 1970 issue (File No. 2/BFO/3). Reprints are available through the Information Service.

ELEMENTARY ELECTRONICS: I have ordered a kit for the beginners organ and would like to know if you could publish a small, simple amplifier with a three inch speaker in the "Elementary Electronics" section. I enjoy reading "Electronics Australia" and find the

NOTES AND ERRATA

LOW NOISE PREAMPLIFIER: (September 1971, File No 1/PRE/26) Constructors who have coupled low impedance cartridges to the input via an impedance step-up transformer have found the unit deficient in bass response. This unit requires a low source impedance in order that the feedback loop will function correctly. To solve the problem remove the 1M resistor (R2) and experiment with the values of R1, C2 and C3.

PLAYMASTER GUITAR AMPLIFIER VIBRATO: Certain models of the Playmaster Guitar Amplifiers incorporate an LDR as part of the vibrato system. Some readers have experienced a problem of volume change as the "Depth" control is varied from one extreme to the other. To encompass device spread in the LDRs used in this section, replace the 15k resistor at the zero end of the Depth control with a series combination of a 22k preset potentiometer and 4.7k resistor. With the vibrato "off", adjust the preset pot for no change in volume level from one extreme to the other of the "Depth" control.

LOW COST STEREO (Jan 1972): Two 3.3k resistors, shown on the circuit diagram have been omitted from the parts list. "2 8uF 18VW" should read "1 8uF 18VW". The 10k stabilising resistor shown on the circuit diagram from the moving arm of the volume control is placed in the moving arm of the bass control on the circuit board. These positions should be linked and the resistors placed on the top of the board in the volume control circuit as per the circuit diagram.

PLAYMASTER 132 AMPLIFIER (June 1971): If difficulty is experienced with setting the power supply output to 60 volts, an increase of the 6.8k resistor in the lower arm of the "Set 60V" preset pot to 12k should allow sufficient adjustment range if tolerance extremes of components is encountered.

CRYSTAL LOCKED HF RECEIVER (March 1972): A 330pF disc ceramic capacitor from pin 3 of the TAA840 IC is shown connected to common foil. It should be connected to the emitter of the BF194 local oscillator transistor (centre pin) at right angles to the IC axis. In some cases, the inclusion of a 0.1uF ceramic disc capacitor from the speaker "hot" terminal to the common foil area may be required to stabilise the audio section against RF problems. Usually, tight twisting of the volume control leads is all that is required. To guard against marginal instability, it may be necessary in some instances to link pins 6 and 14 of the IC with a short piece of wire on the foil side of the board. The inclusion of a 250uF/12V electrolytic capacitor may also be required across the supply line after the switch to ensure stability towards the end of battery life.

130 RECEIVER: (April 1972, File No 2/SW/62). On page 33, the +20V lead on the audio board should go the hole in the copper adjacent to the collector of TR10. The oscillator coil consists of 40 turns centre tapped, with 4 turns over the earthy end.

TUCKER TIN SSB TRANSMITTER (Feb-April 1972): In Fig 13 reproduced on page 61 of the March article, the jack shown for connection of the CW key should be a closed-circuit type.

PLAYMASTER 132 AMPLIFIER (June 1971) To reduce the risk of failure of the power supply transistors TR27 and TR28 under certain conditions of short circuit trip-out, a BY126-100 (or similar) silicon rectifier diode should be placed between the emitter of TR28 and the base of TR29. This can easily be done by mounting the diode on a small tagstrip adjacent to TR29 (mounted on the back panel), and connecting the flying lead from the circuit board to the anode of this diode in lieu of the base of TR29. The cathode of the diode is then connected to the base of TR29 with a short jumper lead.

AC REGULATOR FOR ENLARGERS (Feb, 1972, File No 2/PC/17): Although we made extensive enquiries before describing this project on the availability of 110 volt enlarger lamps — and were assured stocks were available — it appears that some readers have had problems in obtaining them. We have located some of these lamps, which are available, via retailers, from Sixteen Millimetre (Aust) Pty Ltd, of 55 Murray Street, Pyrmont, NSW 2009. Three wattages are available, namely 75, 150 and 300. The recommended retail prices are, respectively, $1.50, $1.80 and $3.50 (plus sales tax). Victorian retailers should direct enquiries to the Melbourne office of Sixteen Millimetre. We strongly suggest readers do not start construction of this project until the correct bulbs are actually in hand.

TTL GATES Dual in Line

7400 quad 2 input nand	.30
7401 quad 2 input nand	.30
7402 quad 2 input nor	.30
7404 hex inverter	.30
7405 hex inverter	.30
7410 triple 3 input nand	.30
7420 dual 4 input nand	.30
7430 8 input nand	.30
7440 dual 4 input buffer	.30
7450 expandable dual 2/ 2 and/ or	.30
7451 dual 2/ 2 and-or	.30
7453 4/ 2 and-or	.30
7460 dual 4-input expander	.30
74H00	.40
74H01	.40
74H04	.40
74H10	.40
74H20	.40
74H51	.40
74H61	.40
8424 low power dual RS/ T	.30
8H2175 MC (typ.) dual JK	1.25
LU321 dual JK "Utilogic"	.60
7472 JK 2/ and inputs	.40
7473 dual JK	.65
7474 dual type "D"	.50
7476 dual JK 2/ set and reset	.65
74107 dual JK	.60
7490 decade counter	1.40
7492 divide by 12 counter	1.40
7493 4 bit binary counter	1.40
8280 45 MC presentable decade counter	1.40
8281 45 MC presentable binary counter	1.40
74192 up/ down decade counter	2.25
8520 25 MC divide by "N" 2 to 15	2.00
74193 up/ down binary counter	2.00
7406 hex inverter buffers/ drivers with 30v open-collector	2.00
7408 quadruple 2-input positive and gates	.40
7411 triple 3-input and gate	.45
7413 dual 4-input nand Schmitt triggers	1.75
7489 64 bit random access memories	4.00
74123 dual retriggerable monostable multivibrators with clear	2.50
7475 quad latch	1.50
7480 gated full adder	.80
7483 4 bit full adder	1.60
74121 one shot multivibrator	1.25
74122 one shot multivibrator	1.50
7491 8 bit, SI, SO	1.40
7495 4 bit PI, PO, LR	1.40
74195 4 bit PI, PO	1.40
8570 8 bit SI, PO	3.00
8590 8 bit PI, SO	2.00
8270 4 bit PI, SI, PO, SO	1.40
7441 BCD "Nixie" decoder	1.50
7442 BCD decoder driver	1.40
7446 7 segment 30v driver	3.00
7447 7 segment 15v driver	2.50
7448 7 segment decoder	1.40
74154 1 of 16 decoder (24 pin)	2.50
74153 dual 4 to 1 line selector 4 bit magnitude comparator A>B, A>B, A>B outputs	1.60
8210 8 line to 1 line selector	1.40
8220 parity gen/ checker	.75
7486 exclusive (quad) or	.65

LINEARS — PACKAGE AS NOTED

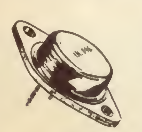
LM100 positive dc regulator TO-5 device provides 20 ma, 2-35v out (up to 5 amps. with ext. transistors.) TO-5	.80
NE526 high speed comparator	1.00
NE565 phase lock loop TO-5	5.75
NE566 function generator TO-5 or DIP (8 pin) no choice	5.75
NE567 tone decoder DIP (8 pin)	5.75
709 popular op amplifier DIP	.50
710 voltage comparator DIP	.65
711 dual comparator DIP	.75
741 compensated op-amp TO-5	.75
5558 dual 741 op-amp (8 pin) DIP	1.25
LM302 op-amp voltage follower 1000 megohm input .999v gain TO-5	1.25
747 Dual 741 op-amp DIP	1.25

LINEAR SPECIAL

Ten (10) 741 fully compensated operational amplifiers with data sheet and two (2) pages of application notes covering the basic circuits for op-amps.

EACH .70 **PACKAGE $6.50**

Please specify first and second choice of: TO-5, 8 pin MINI DIP, 14 pin DIP.



LM309K — 5 volt regulator — This TO-3 device is a complete regulator on a chip. The 309 is virtually blowout proof, it is designed to shut itself off with overload of current drain or over temperature operation. Input voltage (DC) can range from 10 to 30 volts and the output will be five volts (tolerance is worst case TTL requirement) at current of up to one ampere

Each $2.40
Five for $10.00

COUNTER DISPLAY KIT — CD — 2

This kit provides a highly sophisticated display section module for clocks, counter or other numerical display needs. The RCA DR-2010 Numitron display tube supplied with this kit is an incandescent seven segment display tube. The 6 inch higher number can be read at a distance of thirty feet. RCA specs. provide a minimum life for this tube of 100,000 hours (about 11 years of normal use). A 7490 decade counter IC is used to give typical count rates of up to thirty MHz. A 7475 is used to store the BCD information during the counting period to ensure a non-blinking display. Stored BCD data from the 7475 is decoded using a 7447 seven segment decoder driver. The 7447 accomplishes blanking of leading edge zeroes, and has a lamp test input which causes all seven segments of the display tube to light.

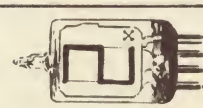
Kit includes a two sided (with plated through holes) fibreglass printed circuit board, three IC's, DR-2010 (with decimal point) display tube, and enough Molex socket pins for the IC's ....

Circuit board is 8 inches wide and 4⅜ inches long. A single 5 volt power source powers both the IC's and the display tube ....

CD-2 kit complete only $12.00 assembled and tested $13.00

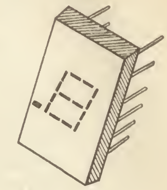
DTL GATES

MC830 dual 4 in expandable nand	.35
MC836 hex inverter	.35
MC846 quad 2 input gate	.35
MC862 triple 3 input gate nand	.35
MC852 dual JK DTL	.70
MC853 dual JK DTL	.35



RCA DR2010 Numitron digital display tube. This incandescent five volt seven segment device provides a 6 inch high numeral which can be seen at a distance of 30 feet. The tube has a standard nine pin base (solderable) and a left hand decimal point.

Each $5.00



LED DISPLAY

Seven segment diffused planar GaAsP light emitting diode array. It is mounted on a dual in line 14 pin substrate and then encapsulated in clear epoxy for protection. It is capable of displaying all digits and nine distinct letters ....

Features:

High brightness . . typically 350 ft-L at 20ma.
Single plane, wide angle viewing . . . . . 150 degrees.
Unobstructed emitting surface
Standard 14 pin dual in line package
Long operating life . . . Solid state
Operates with IC voltage requirements.

Only $4.50

ME-2 Invisible infrared emitter high power, 1A at 1.5V TO-5 **$3.00**

Light Emitting Diode Devices (LED)

MV-50 visible red emitting 10-40ma at 2V **.60**
10 for **$5.00**

MV-10B Visible red emitter
5-70ma at 2V .75

BUY STATE OF THE ART SEMI CONDUCTOR PARTS DIRECT FROM THE USA

All goods are sold on a money back giarantee ....
All prices are in Australian currency, we will accept money orders, bank cheques, and company cheques (from rated firms) in Australian dollars ....
Goods are shipped within 24 hours of receipt of order ....
Goods will be carefully packed and all custom forms will be attached ....
Due to paper work and high postage costs we cannot accept orders for less than $5.00.
Orders for more than $10 will be shipped via Air Mail, orders for less will be shipped surface mail ...
Do not add anything for postage, it is included in price ......

BABYLON ELECTRONICS

P. O. BOX J
CARMICHAEL, CALIFORNIA 95608
(916) 966-2111

PA AMPLIFIER . . . (from Page 49)

coupling capacitor should be within 1 volt of half the supply voltage, ie, if the supply voltage is 48 volts, the voltage across the capacitor should be between 23 and 25 volts.

Having connected the power amplifier and assured that it is working correctly, the mixer board can be connected. The voltages on this board should be measured with a 20,000 ohm / volt meter and should be within 1 volt of the values indicated on the circuit.

Incidentally the amplifier may be operated safely without a load.

The following is a list of precautions which should be followed to ensure reliable operation:

(a) The main amplifier must be built on the printed board. Other methods of construction may lead to instability and "motorboating".

(b) Never connect the power amplifier IC to the supply unless it is properly bolted to the rear of the chassis or an efficient heatsink.

(c) Do not short the output intentionally. In the event of accidents the fuse should blow, but it is an unwise practice to "tempt fate".

Careful attention to the details of this article should provide a high performance unit that should give years of reliable service.

SERVICEMAN . . . (from Page 55)

to its full height.

That was enough. I reefed the capacitor out and measured it. It was a better resistor than a capacitor, tipping the scale at a neat 1 megohm.

Which was all very gratifying, but I was still puzzled as to the purpose of the capacitor, particularly as its removal had no apparent effect on the behaviour of the set.

Finally, I rang the manufacturers. Their explanation was that it was originally included ". . . to counter problems due to flashover in the tube."

I must confess I was somewhat puzzled by this statement. For one thing I was surprised that such a precaution should be necessary in a valve set, and also that the precaution should take this form.

While I have seen plenty of sets fitted with protective devices between the picture tube pins, these have invariably been transistor sets, the risk being that flashover inside the tube could damage expensive transistors. And the protective devices have invariably been spark gaps, not capacitors.

I can only assume that a surge or spike of some kind was anticipated on one or other of these lines and the capacitor was intended to take some of the sting out of it.

As it transpired, these speculations were somewhat academic, because the chap at the other end of the phone went on to explain that the capacitor had given a lot of trouble due to leakage, and it was now recommended that it be deleted. Presumably it created more trouble by going leaky than it prevented by controlling the anticipated spikes.

Nor would this be the first time something like this has happened in the TV industry.

ANSWERS . . . (from Page 111)

"Elementary Electronics" section most useful. The other sections seem to be a little too advanced for me. Perhaps you could publish a project which you think would be suitable for a school club — one which is reasonably cheap. (J.S., Wudinna, SA.)

Thank you for your suggestions and the remarks about the "Elementary Electronics" section. We are pleased to learn that it is helping some of our younger readers. We have been thinking of projects along the lines which you have suggested for some time, and will try to schedule them in the not too distant future.

COLOUR TV: With the advent of colour TV to Australia shortly, I would like to know if there is any information available on the theory of operation of the camera equipment. I can understand the operation of a black and white camera, but cannot find any information on colour cameras. (J.G., Quakers Hill, NSW).

Information on colour camera theory and operation can be obtained from such publications as RCA Review, Philips Technical Review, and Mullard Technical Communications. A browse through a library at a tech college or university will probably yield the above publications, together with other books on the subject.

MUSICOLOUR: I am in the process of building a Musicolour 2, as in the December 1971 issue. I am having difficulty in obtaining the FETs and PUTs. I have some 40583 Diacs which I am thinking of using instead of the PUTs. Will they work? Could you tell me the prices of the board 71/c12, and the metalwork. (M.V., Christchurch, NZ.)

The Diacs cannot be used in the Musicolour 2, MV. They would certainly not work. The Musicolour 1 (October 1969, File No 2/PC/8) used diacs, but, it is nowhere near as sensitive as the Musicolour 2. "Electronics Australia" does not deal in parts, etc, for the projects it features. Enquiries for these should be direct to the advertisers concerned.

DIODE RATINGS AND HUM ELIMINATION: Please accept my compliments on a fine magazine. I must agree with T.L. of Arncliffe re the dating of the spine for the volume binder. Referring to diode ratings, what is meant by PIV? Also, is there any way of eliminating hum developed between a record player and amplifier? (G.C., Ouyen, Vic.)

Thank you for your comments about the magazine and binder, G.C. The term "PIV" as applied to data on diode ratings, refers to the "peak inverse voltage", or the absolute maximum allowable voltage that can be applied across a diode in the reverse biased mode. It is particularly important where the rectifier is feeding a capacitor, as in a typical power supply filter network. During the half cycle when the rectifier is not conducting, the voltage applied to it in the reverse direction will be the sum of the voltage across the capacitor and the voltage across the AC supply terminals, these two voltage sources being effectively in series. As an example, the minimum peak inverse voltage rating a diode must have when feeding a capacitor input filter, is 1.4 times the RMS AC voltage, PLUS the DC across the capacitor, which is also 1.4 times the RMS input. In other words, 2.8 times the RMS input to the diode rectifier. In the case of a bridge, each diode sees 1.4 times the RMS input. Mains hum produced when a record player is connected to an amplifier is usually caused by "earthing" arrangements between the amplifier and pickup, and record player and power outlet. Generally the easiest way to eliminate the hum is to isolate the pickup arm and its shielded cable from the record player deck, and connect to the amplifier by the shielded cable only. The record player return can then be run either to the power point, or to the amplifier chassis. Hum can also be introduced by magnetic radiation from the player motor, but this can only be minimised by choice of a suitable mounting position for the pickup arm.

ELECTRONIC ORGANS

Do not start to build yourself an organ without first finding out about the superb **SCHOBER (USA)** assemble-it-yourself kits. Inquiries to **Schober Organs (Aust), 124 Livingstone Ave., Pymble, NSW, 2073.** (Mail only please.)

THE RECIPROCATING DETECTOR

— A remarkable development in communications technology. Read about it in the June **Australian EEB**. Also, "Modulated Light Communication", and much more.
—**EEB** is always late, so you still have time to get your June issue. Send $1.55 for a year's worth of **EEB** (6 issues) to:

THE SUBSCRIPTION MANAGER, EEB
115 Wilmot St., Huonville, Tasmania. 7109.

C.D.I. TRANSFORMERS

6 & 12 volt negative and positive polarities. ONLY $6.00 incl tax. Pack and post 50c extra. Free converter circuit supplied with every transformer.
See page 115 Jan 71 'Electronics Aust'

F. MIHAI
48 CHAPEL ROAD,
MOORABBIN VIC 3189 Tel 95 4839

"Amateur Electro-plater's Guide."

Elementary practical text describes fully how to plate at home with copper, nickel, silver, gold, rhodium, also aluminium anodising. $1.30, including postage. Available only from:

Patrician Trade Services,
P.O. Box 114, Stafford. Q. 4053

MODERN ELECTRONICS

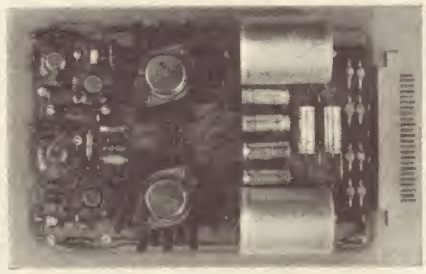
Due to successful advertisement in the past, we are pleased to offer the following specials. . . . All marked and guar...

Popular 200H multimeter $9.95 complete ½ watt 5% resistors 1 ohm to 10 meg 3.5c each, $2.75 per 100; 1 watt 6c or $5 per 100; 0a91 diodes 20c $1.80 per 10; EM401 25c $2.20 per 10; EM404 30c $2.80 per 10; BC107, 8 or 9 35c each or $3 per 10; Speaker cable 2c foot $5.50 100yds hook up cable in 10 colours 4c yd; all gauges winding wire available. Magnetic earpieces 3.5mm plug 35c $3 per 10. Alligator clips (4 colours 10c, $1 per 12; UG88u coax connectors $1.35 each. Tantlum capacitors all in ufd. .1, .47, 1, 2.2, 3.3 (35v) 4.7, 6.8 (25v) 10 (16v) 15 (10v) 22 (6.3v) at 25c each, any 10 at less 10%. 10uf (25v) 22 (16v) and 50 (6.3v) at 35c each. BAX13 diodes at 35c each. BRY39-3N81 and BD182 on application. All prices include tax. Plus postage. We stock a complete transistor range.

Many others, come visit our showrooms for fantastic specials. Write today for free semiconductor price list. All inquiries welcome, including Pacific Islanders and Asians. $NZ, Fiji and US accepted.

Open Friday nights. Other nights can be arranged. Ring 654 3761. Modern Electronics 94 Elizabeth Street, Melbourne. All mail to GPO Box 5402CC, Melbourne, Victoria 3001, Australia.

POWER MODULES



- Single and Dual Outputs
- Output Voltages to 50 Volts
- Output Current to 2.0 Amps
- Line and Load Regulation — Less than 0.01%
- Short Circuit proof

SCIENTIFIC ELECTRONICS PTY LIMITED

42 Barry Street, Bayswater, Vic 3153. Phone:

Melbourne 729 3170; Brisbane 47 4311; Adelaide 77 1325; Perth 21 6146

COLLINS COMMUNICATIONS RECEIVERS

Inquiries are invited for the purchase of as new Collins Communications Receivers type 390 & 390A, .5 to 32MHz. Digital Read Out. 1MHz Bands. Dial Calibration 200Hz. Crystal synthesising driftless Rx. (Finance Available).

Apply in writing to:
Industrial and Medical Electronic Company,
6th Floor, 288 Little Collins Street, MELBOURNE.
Phone: 63-9258.

WHY TRAVEL TO THE CITY??? ELECTRONICS SPARES

102 Queen St., ST. MARYS, N.S.W. 2760

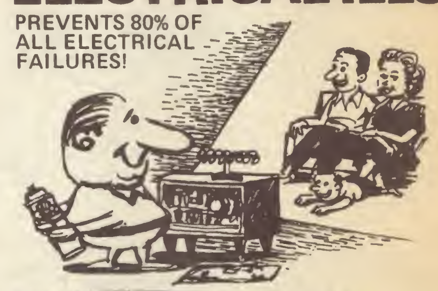
SEMICONDUCTORS

AC125	.74	MPF102	.78	2N5459	$1.00
AC127/128	$1.70	OC44N	.48	2N5485	$1.50
AC187/188	$1.90	OC45N	.48	AY6108	$1.36
AD149	$2.10	OC72	.48	AY6109	$1.36
AD161/162	$2.95	OC74N	.75	AA119	.30
AF116N	.75	OC75N	.75	BA100	.36
BC107	.55	OC81	.65	BA102	.96
BC108	.40	TT797	$2.00	BA114	.31
BC109	.45	TT798	$2.20	OA5	.55
BC177	.75	TT800	$1.36	OA90	.26
BC178	.70	TT801	$1.36	OA91	.17
BC179	.75	2N2646	$1.30	OA95	.31
BD139/140	$5.20	2N2926	.75	OA202	.46
BF115	.63	2N3054	$1.95	IN914	.31
BF167	$1.00	2N3055	$2.00	A15A	.75
BFY50	$1.10	2N3638	.55	EM401	.25
D13T1	$1.35	2N4360	$1.20	EM404	.30

Pack & Post ....20c Phone 623-0346 for C.O.D.

A CURE FOR ELECTRICAL ILLS

PREVENTS 80% OF ALL ELECTRICAL FAILURES!



... the "TOOL KIT IN-A-CAN"

with the

QUICK FIX-IT *ACTION*

USE

CRC®

2·26

ELIMINATES MOISTURE PROBLEMS—DEPOSITS THIN FILM MOISTURE BARRIER—PREVENTS CORROSION OF METAL —LUBRICATES, PENETRATES, CLEANS.

USE IN INDUSTRY .....

ON — Air Conditioners, Alarms, Battery Cables, Blowers, Bulb Terminals, Bus Bars, Bushings, Cable Lubricant, Circuit Breakers, Coils, Coin Slots, Conductors, Conduits, Contacts, Controls, Elevator Equip., Fans, Filters, Fire Alarms, Fixtures, Fuses, Gauges, Generators, Hearing Aids, Housings, Ignitions, Instruments, Meters, Microphones, Motors, Oscillators, Panel Boards, Parking Meters, Plugs, Potentiometers, Receivers, Receptacles, Refrigeration, Relays, Rheostats, Signal Systems, Sockets, Solenoids, Speakers, Switches, Switch Gear, Synchronisers, Telephone Equip., Terminal Blocks, Timers, Tooling, Transformers, Transmitters, Tubes, Welders, Wet Splices, Wire & Cable.

available from your Electrical Wholesale Distributor.
A HIGH QUALITY PRODUCT OF
CRC CHEMICALS AUSTRALIA PTY. LTD.

BASF's new Chromdioxid cassette brings you the other half of the fiddle

Only BASF's new Chromium Dioxide coating can give you a dynamic range good enough to reproduce the most subtle tops of a violin. Or the deepest notes of a double bass. Until now cassettes have had poor bass response–and even poorer treble response. They only gave you half the sound. BASF's new Chromdioxid lets you hear it all.

And BASF's new internal transport system prevents foul-ups, no matter what tape thickness you use. It also stops the wow and flutter you get from variations in tape tension. Chromdioxid cassettes give you sound quality that you would only expect from reel to reel. Without all the fiddling.

FIRST IN TAPE

BASF

Distributors: Sydney: Maurice Chapman & Co. Pty. Ltd., 276 Castlereagh St., 2000. **Newcastle:** W. L. Redman Agencies, 11 Hall St., N.S.W., 2300. **Fyshwick:** Sonny Cohen & Sons, 20 Isa St., A.C.T., 2600. **Hawthorn:** Maurice Chapman & Co. Pty. Ltd., 146-150 Burwood Rd., Vic., 3122. **West End:** Chandlers Pty. Ltd., 399 Montague St., Qld., 4101. **Unley:** Neil Muller Pty. Ltd., 8 Arthur St., S.A., 5061. **Belmont:** Anderson-Tedco, 11-13B Belmont Ave., W.A., 6104. **Launceston:** P. & M. Distributors, 87A Brisbane St., Tas., 7250. **Darwin:** Pfitzners Music House, 2 Darwin Arcade, Smith St., N.T., 5790.

BA1969